RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

This Official Bid Document consisting of pages 1 through 17, shall be used in submitting a bid document for the work. Copies will be furnished upon request by the authority issuing the Contract Documents.

| rumshed upon request by the a | authority issuing the contract | bocuments. | |
|--|---|---|-------------------------------------|
| THIS BID DOCUMENT SUB | MITTED BY | | |
| | | | |
| | (Name | and Address of Bidder) | |
| DATE: | 1 | TELEPHONE: | |
| | | | |
| | | | |
| | | | |
| GENTLEMEN: | | | |
| Contract Documents as define Tarrant Architects, Inc.; hereb | d in Article 1 of the General y proposes to furnish all labo | RFB-122-22, and having carefully ex Conditions as well as the Specification or, materials, supplies and services requor the stated Lump Sum Bid Amount. | ns for the work as prepared by Ross |
| The Bidder hereby acknowledge | ges receipt of the following A | ddenda: | |
| ADDENDUM NO | DATED | ADDENDUM NO | DATED |
| ADDENDUM NO | DATED | ADDENDUM NO | DATED |
| ADDENDUM NO | DATED | ADDENDUM NO | DATED |
| ADDENDUM NO | DATED | ADDENDUM NO | DATED |

(IF NONE HAVE BEEN ISSUED AND RECEIVED, INSERT THE WORD NONE.)

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

ALL BLANKS IN THE BID DOCUMENTS SHALL BE COMPLETED AND ALL REQUIRED SUPPORT DATA SHALL BE FURNISHED. IF INDICATED IN THE BIDDING DOCUMENTS, SUMS SHALL BE EXPRESSED IN BOTH WORDS AND FIGURES. IN THE CASE OF DESCREPANCY BETWEEN THE TWO, THE AMOUNT IN WORDS SHALL PREVAIL.

LUMP SUM BASE BID:

The Bidder agrees to furnish all labor, materials, supplies and services required to complete this project defined as RE-ADVERTISEMENT OF RFB-73-22, Student Center Building Renovation, Elizabethtown Community & Technical College, Elizabethtown, Kentucky for the Department for Facilities and Support Services, Commonwealth of Kentucky, in accordance with the Drawings, Specifications, and Contract Documents, and any duly issued Addenda for the LUMP SUM BID AMOUNT set forth below:

| LUMP SUM BASE BID AMOUNT: | | |
|--|---|--|
| | | |
| | | |
| | | DOLLARS |
| | (USE WORDS) | |
| | | |
| | CENTS (\$ | |
| (USE WORDS) | | (USE FIGURES) |
| ADDITIVE ALTERNATE #1: Terrace addition, in systems. | cluding but not infined to an structure | e, rannigs, and new openings for storenone |
| | | DOLLARS |
| | (USE WORDS) | |
| | CENTER (A | |
| (USE WORDS) | CENTS (\$ | (USE FIGURES) |
| (USE WONDS) | | (USE FIGURES) |

NOTE: THE AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST PAGE <u>MUST</u> BE PROPERLY EXECUTED FOR THE LUMP SUM BASE BID TO BE VALID.

| <u>ADDITIVE ALTERNATE #2:</u> | Fit-out of the Codin | g Academy classroom | | |
|-------------------------------|----------------------|---------------------|---------------|---------|
| | | | | |
| | | | | |
| | | | | |
| | | (TIGE WORDS) | | DOLLARS |
| | | (USE WORDS) | | |
| | | | | |
| | | | | |
| | | CENTS (\$ | |) |
| (USE | WORDS) | | (USE FIGURES) | |
| | | | | |
| ADDITIVE ALTERNATE #3: | Fit-out of the Trans | fer Office Suite. | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | DOLLARS |
| | | (USE WORDS) | | |
| | | | | |
| | | | | |
| | | CENTS (\$ | |) |
| (USE | WORDS) | | (USE FIGURES) | |
| | | | | |

 $\underline{NOTE:}$ THE AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST PAGE \underline{MUST} BE PROPERLY EXECUTED FOR THE LUMP SUM BASE BID TO BE VALID.

AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST

I, HEREBY CERTIFY:

- 1. That I am the bidder (if the bidder is an individual), a partner in the bidder (if the bidder is a partnership), or an officer and employee of the bidding corporation having authority to sign on it's behalf (if the bidder is a corporation);
- 2. That the submitted bid or bids covering Division of Engineering and Contract Administration Request for Bid No. RFB-122-22 have been arrived at by the bidder independently and have been submitted without collusion with, and without any agreement, understanding or planned common course of action with any other contractor, vendor of materials, supplies, equipment or services described in the Request for Bid, designed to limit independent bidding or competition; as prohibited by provision KRS 45A.325;
- 3. That the contents of the bid or bids have not been communicated by the bidder or its employees or agents to any person not an employee or agent of the bidder, its surety on any bond furnished with the bid or bids and will not be communicated to any such person prior to the official opening of the bid or bids.
- 4. That the bidder is legally entitled to enter into the contract with the Commonwealth of Kentucky and is not in violation of any prohibited conflict of interest, including those prohibited by the provisions of KRS 164.390; and 45A.330 to 45A.340 and 45A.455;
- 5. This offer is for thirty (30) calendar days from the date this bid is opened. In submitting the above it is expressly agreed that upon proper acceptance by the Division of Engineering and Contract Administration of any or all items bid above, a contract shall thereby be created with respect to the items accepted;
- 6. That I have fully informed myself regarding and affirm the accuracy of all statements made in this Official Bid Document including Bid Amount.
- 7. Unless otherwise exempted by KRS 45.590, the bidder intends to comply in full with all requirements of the Kentucky Civil Rights Act and to submit data required by the Kentucky Equal Employment Act upon being designated the successful bidder.
- 8. That the bidder, if awarded a contract, would not be in violation of the Executive Branch Code of Ethics established by KRS 11A.001 through KRS 11A.990.
- 9. That the bidder is not debarred from doing business with federal agencies and that, if debarred during the life of the contract, the bidder will notify the Commonwealth buyer of record within seventy-two (72) hours of the federal debarment.

READ CAREFULLY - SIGN IN SPACE BELOW - FAILURE TO SIGN INVALIDATES BID

| SIGNED BY: | | FIRM: | |
|----------------|--|--|----------|
| PRINT NAME: | | ADDRESS: | |
| TITLE: | | | |
| DATE: | | CITY STATE TELEPHONE NO: | ZIP CODE |
| FEDERAL ID. NO | OR SOCIAL SECURITY NO. | EMAIL: | |
| | *Disadvantaged Contractor WBE MBE DBE | rs, check type of certification: SERVICE-DISABLED VETERAN | |

^{*}Disadvantaged Contractors attach a copy of certification.

OFFICIAL BID DOCUMENT - SUBMITTAL DATA

THE FOLLOWING ITEMS ARE HEREWITH ENCLOSED AS REQUIRED:

| Sworn Required Affidavit For Bidders, Offerors And Contractors |
|---|
| Sworn Affidavit for Claiming Resident Bidder Status |
| Vendor Report of Prior Violations of KRS Chapters, 136, 139, 141, 337, 338, 341 and 342. |
| Bidder's Qualifications. |
| Disadvantaged Business Enterprises (DBE) Participation |
| Disadvantaged Business Enterprises (DBE) Participation The utilization of minority/disadvantaged vendors and subcontractors is encouraged, whenever possible, on public projects. The bidder and contractor should make full efforts to locate disadvantaged business persons. Bidders may use the following resources: Commonwealth of Kentucky's SMALL BUSINESS CONNECTION website: https://secure.kentucky.gov/sbc/default.aspx Kentucky Minority and Women Business Enterprise website: https://mwbe.ky.gov/Pages/default.aspx Kentucky Minority and Women Business Enterprise directories: https://mwbe.ky.gov/initiatives/sdvosb/Pages/default.aspx Kentucky Transportation Cabinet Disadvantaged Business Enterprise directories: https://transportation.ky.gov/Civil-Rights-and-Small-Business-Development/Pages/Certified-DBE-Directory.aspx Finance and Administration Cabinet, Office of EEO/Contract Compliance: email finance-ContractCompliance@ky.gov or call 502-564-2874 U.S. Small Business Administration, Dynamic Small Business Search website: http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm Louisville/ Jefferson County Metropolitan Sewer District website: http://www.msdlouky.org/insidemsd/diverse/find.html A bidder must include a list of all disadvantaged vendors and/or subcontractors, a statement must be included to describe actions to include disadvantaged vendors and/or subcontractors, a statement must be included to describe actions to include disadvantaged vendors and/or subcontractors, if applicable List of Materials a |
| Bid Guaranty in the amount of no less than five percent (5%) of the TOTAL BID AMOUNT. |
| Roofing Certifications, if applicable. |
| |

COMMONWEALTH OF KENTUCKY FINANCE AND ADMINISTRATION CABINET SWORN STATEMENT REGARDING CAMPAIGN FINANCE LAWS PURSUANT TO KRS 45A.110 AND KRS 45A.115

The following form (page 5) relative to Campaign Finance Laws shall be completed in total, notarized and returned with your bid. Responsibility of a bidder or offeror for a contract award shall not be made until the bidder or offeror provides this sworn statement.

ANNUAL REQUIRED AFFIDAVIT FOR BIDDERS, OFFERORS AND CONTRACTORS

Page 1 of 2

| Affidavit Effective Date: | |
|-----------------------------------|--------------|
| Affidavit Expiration Date: | |
| Maximum Ler | gth One-Year |

FOR BIDS AND CONTRACTS IN GENERAL:

- I. Each bidder or offeror swears and affirms under penalty of perjury, that to the best of their knowledge:
 - a. In accordance with KRS 45A.110 and KRS 45A.115, neither the bidder or offeror as defined in KRS 45A.070(6), nor the entity which he/she represents, has knowingly violated any provisions of the campaign finance laws of the Commonwealth of Kentucky; and the award of a contract to the bidder or offeror or the entity which he/she represents will not violate any provisions of the campaign finance laws of the Commonwealth.
 - b. The bidder or offeror swears and affirms under penalty of perjury that, to the extent required by Kentucky law, the entity bidding, and all subcontractors therein, are aware of the requirements and penalties outlined in KRS 45A.485; have properly disclosed all information required by this statute; and will continue to comply with such requirements for the duration of any contract awarded.
 - c. The bidder or offeror swears and affirms under penalty of perjury that, to the extent required by Kentucky law, the entity bidding, and its affiliates, are duly registered with the Kentucky Department of Revenue to collect and remit the sales and use tax imposed by KRS Chapter 139, and will remain registered for the duration of any contract awarded.
 - d. The bidder or offeror swears and affirms under penalty of perjury that the entity bidding is not delinquent on any state taxes or fees owed to the Commonwealth of Kentucky and will remain in good standing for the duration of any contract awarded.
 - e. The bidder or offeror swears and affirms under penalty of perjury that the entity bidding, is not currently engaged in, and will not for the duration of the contract engage in, the boycott of a person or an entity based in or doing business with a jurisdiction with which Kentucky can enjoy open trade, as defined in KRS 45A.607.
 - f. The bidder or offeror swears and affirms that the entity bidding, and all subcontractors therein, have not violated any of the prohibitions set forth in KRS 11A.236 during the previous ten (10) years, and further pledge to abide by the restrictions set forth in such statute for the duration of the contract awarded.

FOR "NON-BID" CONTRACTS (I.E. SOLE-SOURCE; NOT-PRACTICAL OR FEASIBLE TO BID; OR EMERGENCY CONTRACTS, ETC):

- I. Each contractor further swears and affirms under penalty of perjury, that to the best of their knowledge:
 - a. In accordance with KRS 121.056, and if this is a non-bid contract, neither the contractor, nor any member of his/her immediate family having an interest of 10% or more in any business entity involved in the performance of any contract awarded, have contributed more than the amount specified in KRS 121.150 to the campaign of the gubernatorial slate elected in the election last preceding the date of contract award.
 - b. In accordance with KRS 121.330(1) and (2), and if this is a non-bid contract, neither the contractor, nor officers or employees of the contractor or any entity affiliated with the contractor, nor the spouses of officers or employees of the contractor or any entity affiliated with the contractor, have knowingly contributed more than \$5,000 in aggregate to the campaign of a candidate elected in the election last preceding the date of contract award that has jurisdiction over this contract award.
 - c. In accordance with KRS 121.330(3) and (4), and if this is a non-bid contract, to the best of his/her knowledge, neither the contractor, nor any member of his/her immediate family, his/her employer, or his/her employees, or any entity affiliated with any of these entities or individuals, have directly solicited contributions in excess of \$30,000 in the aggregate for the campaign of a candidate elected in the election last preceding the date of contract award that has jurisdiction over this contract.

ANNUAL REQUIRED AFFIDAVIT FOR BIDDERS, OFFERORS AND CONTRACTORS

Page 2 of 2

As a duly authorized representative for the bidder, offeror, or contractor, I have fully informed myself regarding the accuracy of all statements made in this affidavit, and acknowledge that the Commonwealth is reasonably relying upon these statements, in making a decision for contract award and any failure to accurately disclose such information may result in contract termination, repayment of funds and other available remedies under law. If the bidder, offeror, or contractor becomes non-compliant with any statements during the affidavit effective period, I will notify the Finance and Administration Cabinet, Office of Procurement Services immediately. I understand that the Commonwealth retains the right to request an updated affidavit at any time.

| Signature | Printed Name | | |
|--|---------------|-------------|--|
| Title | Date | | |
| Company Name | | | |
| Address | | | |
| | | | |
| Commonwealth of Kentucky Vendor Subscribed and sworn to before me by | (Affiant) | (Title) | |
| of (Company Name) | day of | ,20 | |
| Notes Dally | | _ | |
| Notary Public | | | |
| [seal of notary] | My commission | on expires: | |

REQUIRED AFFIDAVIT FOR BIDDERS, OFFERORS AND CONTRACTORS CLAIMING RESIDENT BIDDER STATUS

FOR BIDS AND CONTRACTS IN GENERAL:

The bidder or offeror hereby swears and affirms under penalty of perjury that, in accordance with KRS 45A.494(2), the entity bidding is an individual, partnership, association, corporation, or other business entity that, on the date the contract is first advertised or announced as available for bidding:

- 1. Is authorized to transact business in the Commonwealth;
- 2. Has for one year prior to and through the date of advertisement
 - a. Filed Kentucky income taxes;
 - b. Made payments to the Kentucky unemployment insurance fund established in KRS 341.49; and
 - c. Maintained a Kentucky workers' compensation policy in effect.

The BIDDING AGENCY reserves the right to request documentation supporting a bidder's claim of resident bidder status. Failure to provide such documentation upon request shall result in disqualification of the bidder or contract termination.

| Signature | Printed Name | |
|--------------------------------------|-----------------|----------|
| | | |
| Title | Date | |
| Company Name | | |
| Address | | |
| | | |
| | | |
| Subscribed and sworn to before me by | | |
| | (Affiant) | (Title) |
| of | thisday of | ,20 |
| (Company Name) | | |
| | | |
| N. D.I. | | |
| Notary Public | | |
| [seal of notary] | My commission e | veniros. |
| 180a1 01 110tal y 1 | My Commission 6 | ADIICS. |

VENDOR REPORT OF PRIOR VIOLATIONS ON CONSTRUCTION SEALED BIDS

This form is applicable to all sealed bids for construction projects issued by the Finance and Administration Cabinet, Division of Engineering and Contract Administration (DECA) in accordance with KRS 45A.080.

The **Prime Bidder** on any construction sealed bid **shall** provide the required information attached, for the Prime Bidder, as **an attachment to the bid**.

The information required is specifically - any violations issued within the last five (5) calendar years of the following:

- 1. Violations of KRS Chapter 136 (Corporation and Utility Taxes);
- 1. Violations of KRS Chapter 139 (Sales and Use Taxes);
- 2. Violations of KRS Chapter 141 (Income Taxes);
- 3. Violations of KRS Chapter 337 (Wages and Hours);
- 4. Violations of KRS Chapter 338 (Occupational Safety and Health of Employees);
- 5. Violations of KRS Chapter 341 (Unemployment Insurance);
- 6. Violations of KRS Chapter 342 (Workers Compensation); and
- 7. Violations of Occupational Safety and Health Laws in any other states and at the federal level.

If there are no violations for a particular category, vendor should attach a statement to that effect.

VIOLATIONS, YOU CAN FAX OR EMAIL THE LABOR CABINET WITH YOUR REQUEST.

If there are violations for a particular category, the vendor should list them and provide the following information for each: the date of the violation, a short description of the violation (including statutory citation), the name of the governmental enforcement agency involved, and the amount of any penalties imposed as a result of the final determination.

Please note that this information may be provided to other governmental agencies, such as the Kentucky Labor Cabinet, as part of the bid process. DECA reserves the unqualified right to disqualify any vendors from participating further in this bid process.

In addition, the successful prime bidder and subcontractors shall remain in continuous compliance with KRS 45A.485 during the life of any contract awarded, and shall notify DECA of any new final determinations of violations in **any** of the above-mentioned categories, which occur after contract award, and during the life of any contract awarded. Failure to comply with these requirements may result in the bidder and subcontractors being disqualified from participating in future bid opportunities for the Commonwealth.

| TAX PAYER ID #: | | | | |
|-------------------|----------------------------|--------------------------|----------------------|---------------|
| THIS VENDOR VIOLA | TION FORM MAY BE SENT TO | THE LABOR CABINET FOR | R VERIFICATION. PLEA | ASE MAKE SURE |
| ALL YOUR VIOLATIC | ONS ISSUED WITHIN THE LAST | T FIVE (5) YEARS ARE LIS | STED. IF YOU LIST "N | NONE" BUT THE |
| LABOR CABINET'S R | ECORDS SHOW OTHERWISE, Y | YOUR BID MAY BE REJEC | CTED. FOR A LIST OF | YOUR VENDOR |

FAX NUMBER IS (502) 696-1984 OR EMAIL: wages@ky.gov.

COMPANY NAME:

| Violation Category | Date | Description | Govt. Enforcement Agency | Amount of Penalties |
|--------------------|------|-------------|-----------------------------|---------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

BIDDER'S QUALIFICATIONS

| | The Bidder's Qualifications are required by the owner | er to be submitted as set | forth herewith: | | | |
|---|---|---|-----------------|-------------------|--|--|
| | This firm is a Corp, Partnership, | or Proprietorship | · | | | |
| • | A permanent place of business is maintained at: | A permanent place of business is maintained at: | | | | |
| | STREET | CITY | STATE | ZIP CODE | | |
| | TELEPHONE NUMBER | | | | | |
| | The following construction plant and equipment will | | | | | |
| | In the event the contract is awarded the undersigned, | surety bonds will be fur | rnished by: | | | |
| | Experience of Contractor on other similar work: | Experience of Contractor on other similar work: | | | | |
| | | | | | | |
| | We now have the following jobs under contract and b | oonded: | | | | |
| | JOB | TOTAL | CONTRACT | PERCENT COMPLETED | | |
| | | \$ | | % | | |
| | | \$ | | % | | |
| | | \$ | | % | | |
| | | \$ | | % | | |
| | | \$ | | % | | |

DISADVANTAGED BUSINESS ENTERPRISE (DBE) PARTICIPATION

- 1.01 **CERTIFICATION OF DBE:** Any DBE utilized pursuant to this Section shall be certified as a DBE by one of the following: Kentucky Finance and Administration Cabinet, Kentucky Transportation Cabinet or other state Transportation agencies, the Louisville/Jefferson County Metropolitan Sewer District, the Tri-State Minority Supplier Development Council or other state Minority Supplier Development Councils, the Ohio River Valley Women's Business Council, the Women's Business Enterprise National Council, the National Women Business Owners Council, or the Small Business Administration.
- 1.02 **OBLIGATION OF BIDDER/CONTRACTOR:** Bidder/Contractor shall make a good faith effort to meet the DBE contract goal set by the Commonwealth by including DBE's as subcontractors and/or material suppliers on 10% of the total estimated cost of the Contract. The failure to meet the foregoing goal shall not result in disqualification from bidding or being awarded a contract. However, Bidders/Contractors not meeting the DBE goal shall be expected to provide written proof of their good faith efforts. Award of the contract shall be conditioned upon satisfaction of the requirements established by this section. The Bidder/Contractor shall attempt to divide the work in the contract to facilitate use of DBE's (however, there is no requirement that the work be artificially divided or divided in a way that raises the bid price of the Bidder/Contractor).
- 1.03 **PROOF REQUIRED:** Each bidder shall furnish written proof in their bid package that they reached the DBE participation goal for this Contract, or of their good faith efforts to meet the DBE participation goal. A copy of each participating DBE's certification shall accompany the required forms. All submissions shall be subject to verification of the Commonwealth.
 - A. Proof that the apparent successful bidder reached the DBE goal shall consist of the following and shall be made on form DB-2-A, attached hereto:
 - 1. The names and addresses of DBE firms that will participate in the contract;
 - 2. A description of the work each named DBE firm will perform;
 - 3. The dollar amount of participation by each named DBE firm;
 - 4. The percentage amount of participation by each named DBE firm;
 - B. Proof that the apparent successful bidder made a good faith efforts to meet the DBE participation goal may include the following:
 - Advertisement by the Bidder/Contractor of DBE contracting opportunities associated with this
 contract in at least one of each of the following periodicals: a periodical in general circulation
 throughout the Commonwealth, a trade periodical focused on DBE contractors/suppliers in
 general circulation throughout the Commonwealth, and a minority-focused periodical in general
 circulation throughout the Commonwealth. The Bidder/Contractor shall include copies of the
 dated advertisements in his bid package;
 - 2. Written notice of DBE opportunities in this contract to at least five pertinent DBE's at least seven days prior to the bid opening date. Copies of the written notices shall be included in the bid package;
 - 3. The Bidder/Contractor's response(s) to those DBE's who requested plans, specifications and/or contracting requirements. Copies of said responses shall be included in the bid package;
 - 4. Documentation on form DB-2-B of good faith negotiations with at least three DBE's, with no rejection of a qualified DBE without sound reason, including price quotes that are above other subcontractor's price quotes;
 - 5. Utilization of the Finance and Administration Cabinet's Office of Equal Employment Opportunity and Contract Compliance for referrals to organizations that assist in locating DBE's. Proof of use of such referrals and contacts made as a result thereof shall be included in the bid package.

DISADVANTAGED BUSINESS AVAILABILITY VERIFICATION

| | does commi | t itself that on the following project: |
|--|---|---|
| NAME OF COMPANY | | |
| | | |
| PROJECT NAME | REQUEST FOR BID NUMBER | _ |
| 1 ROJECT NAME | REQUEST FOR BID NUMBER | |
| The Bidder agrees to furnish information required intends to utilize. Breach of this commitment commitment commitment commitment commitment. | | |
| NAME OF DISADVANTAGED BUSINESS | TELEPHONE | TYPE OF WORK |
| | | |
| | | |
| | | |
| | | |
| DOLLAR VALUE | PERCENT | DISADVANTAGED CLASSIFICATION |
| | | |
| | | |
| | | |
| | | |
| The undersigned shall enter into a formal agreeme conditioned upon execution of a contract with the Disadvantaged business firms listed above by the work for which they were proposed and accepted Architect/Engineer. The undersigned hereby certithe Bidder to the commitment herein set forth. | Commonwealth of Kentucky. Bidder and accepted by the Owner an and shall not be changed except with the commonwealth of Kentucky. | d the Architect/Engineer shall be used on the the written approval of the Owner and the |
| Signature and title of authorized official of the condeemed nonresponsive. | mpany and the data shall be properly e | executed on this document or the bid will be |
| NAME OF AUTHORIZED OFFICER | TITLE | |
| SIGNATURE | DATE | |
| If you are bidding as a General Contractor on this copy of your DBE Certification. | project i.e. direct bidding and a Disad | vantaged as defined herein, please provide a |
| Submit with Bid. (Please copy additional Disadvantaged Business A | Availability Forms as necessary.) | |

DISADVANTAGED BUSINESS UNAVAILABILITY VERIFICATION

| I, | | (TITLE) |
|--|--|--|
| -£ | | () |
| of(PRI | ME BIDDER) | |
| certify that on I contacted the figure Phone, In Person to obtain a bid for work items to be perfo | following Disadvantaged ormed on the Contract. | owned business by: (circle one) Certified Mail, |
| DISADVANTAGED CLASSIFICATION (IE. WBE, MBE, DBE, SDVOSB) CONTRACTOR | WORK ITEMS SOUGHT | FORM OF BID SUPPORT (I.E., UNIT PRICE, MATERIALS LABOR & LABOR ONLY) |
| | | |
| | | |
| | | |
| To the best of my knowledge and belief, said Disadvantage of agreement on price) for work on this project, or unable t | to prepare a bid, for the fol | llowing reason(s): |
| | | |
| | GLONA TUD | |
| | | E |
| | DATE | |
| | | was offered an |
| (NAME OF DISADV | ANTAGED BUSINESS) | |
| opportunity to bid on the above-identified work on | | by |
| (SOI | URCE) | |
| The above statement is a true and accurate account of why | I did not submit a bid on | this project. |
| | (SIGNATUE | RE OF DISADVANTAGED BUSINESS) |
| | (TITLE) | (DATE) |

Submit with Bid if Applicable.

(Please copy additional Disadvantaged Business Unavailability Forms as needed.)

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

LIST OF UNIT PRICES: (ALL BLANKS MUST BE FILLED IN)

Unit prices shall include the furnishing of all labor, materials, suppliers, services and shall include all items of cost, overhead and profit for the Contractor and any Subcontractor involved, and shall be used uniformly without modification for either additions or deductions. The Unit Prices as established shall be used to determine the equitable adjustment of the Contract Price in connection with changes or extra work performed under the Contract. Failure to completely fill out all unit prices requested may result in bid rejection.

| DESCRIPTION OF WORK | | UNIT PRICE | UNIT OF MEASURE |
|---------------------|--|------------|--------------------|
| 1. | Terrazzo (TR2) Patch and Repair | \$ | SF |
| 2. | Earthwork: Trench Earth Excavation and off-site disposal | \$ | CY |
| 3. | DGA, Installed and Compacted | \$ | CY |
| 4. | 4" depth concrete pavement and aggregate base | \$ | СУ |
| 5. | 4" perf PE Pipe, Installed with 3-foot bury | \$ | LF |

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

LIST OF PROPOSED SUBCONTRACTORS:

(Must be submitted with Bid)

The following list of proposed subcontractors is <u>required by the owner</u> to be executed, completed, and submitted with the Bidder's <u>Proposal</u>. All subcontractors are subject to approval by the Division of Engineering and Contract Administration, Department of Facilities and Support Services, Frankfort, Kentucky. Failure to submit this list, completely filled out, may result in bid rejection.

If certain branches of work are to be done by the Prime Contractor, so state. Review/evaluation of subcontractors will occur on the bid opening day. If the Commonwealth requests replacement of a subcontractor, on bid opening day, then the apparent low bidder will provide a replacement subcontractor prior to close of the Commonwealth's business day on that day. Failure of the apparent low bidder to comply with the preceding sentence may result in bid rejection. If subcontractor review/evaluation is <u>not</u> completed on the bid opening day, then procedures for any replacement will be issued based on the uniqueness of each situation. The responsibility for selection, offering of qualified, competent subcontractors to accomplish the work intended is solely the responsibility of the bidder to the Commonwealth.

ALL BLANKS MUST BE FILLED IN. IF PERFORMED BY THE BIDDER, STATE PRIME/GENRAL CONTRACTOR.

| | BRANCH OF WORK | NAME OF SUBCONTRACTOR |
|-----|---------------------------------|-----------------------|
| | | |
| 1. | Terrazzo (TR2) Patch and Repair | |
| 2. | Doors and Windows | |
| 3. | Concrete | |
| 4. | Steel | |
| 5. | Masonry | |
| 6. | Plumbing | |
| 7. | Fire Protection | |
| 8. | HVAC | |
| 9. | HVAC Controls | |
| 10. | Niagara AX Certified Technician | |
| 11. | Electrical | |
| 12. | Roofing | |
| 13. | Elevator | |

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

LIST OF MATERIALS AND EQUIPMENT (MUST BE COMPLETELY FILLED OUT WHEN BID IS SUBMITTED):

Every item listed under the different phases of construction must be clearly identified so that the Owner will definitely know what the bidder proposes to furnish. Bidders be hereby advised that this list is <u>required by the owner</u> to be executed, completed, and submitted with the Bidder's <u>Proposal</u>.

The use of the manufacturer's dealer's name only, or stating "as per plans and specifications", will not be considered as sufficient identification.

Where more than one "Make or Brand" is listed for any one item, the Owner has the right to select the one to be used.

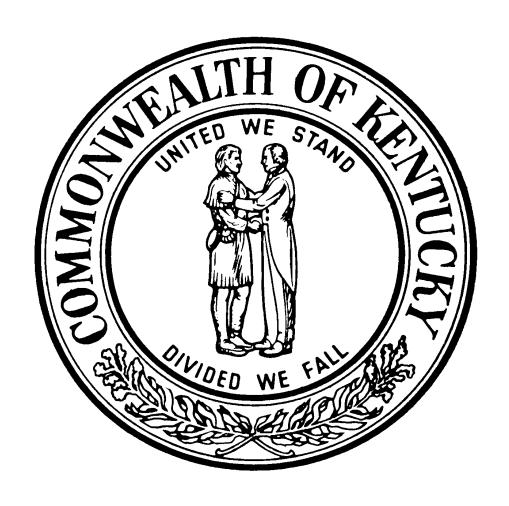
Failure to submit a proper list may result in rejection of Bidder's Proposal.

| | MATERIAL AND/OR EQUIPMENT: | MANUFACTURER AND BRAND NAME: |
|-----|---|------------------------------|
| 1. | Terrazzo (TR2) Patch and Repair | |
| 2. | Steel Fabricator | |
| 3. | Elevator | |
| 4. | Aluminum Storefront Windows | |
| 5. | Exterior Glazing | |
| 6. | Air Cooled Chiller | |
| 7. | HVAC Boiler | |
| 8. | HVAC Pumps | |
| 9. | Dedicated Outside Air Unit | |
| 10. | Fan Coil Units | |
| 11. | Kitchen Hood System (Hood, Fans, and Make-Up Air Unit) | |
| 12. | Water Heater | |
| | Water Softener | |

<u>LIST OF MATERIALS & EQUIPMENT (cont.):</u> (must be submitted with bid)

| 14. | Electrical Equipment | |
|-----|--|--|
| | | |
| 15. | Fire Alarm System | |
| 16. | Light Fixtures (list each type on separate sheet) & Controls | |
| 17. | Data/Communication | |

FINANCE AND ADMINISTRATION DEPARTMENT FOR FACILITIES AND SUPPORT SERVICES DIVISION OF ENGINEERING AND CONTRACT ADMINISTRATION



REQUEST FOR BID NO. RFB-122-22 RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

Agency: 470 Fund: C887



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| NOTICE TO CONTRACTORS |
| PART I ADVERTISEMENT FOR BIDS |
| PART II INSTRUCTIONS TO BIDDERS |
| PART III GENERAL CONDITIONS |
| PART IV PAYMENT BOND |
| PART V PERFORMANCE BOND |
| PART VI AGREEMENT BETWEEN OWNER AND CONTRACTOR |
| SPECIFICATIONS |

PLEASE NOTE THE FOLLOWING:

THE VENDOR VIOLATION FORM IN THE BID DOCUMENTS IS BEING SENT TO THE LABOR CABINET FOR VERIFICATION. PLEASE MAKE SURE ALL YOUR VIOLATIONS ARE LISTED WITHIN THE LAST FIVE (5) YEARS. IF A BIDDER LISTS "NONE" AND HAS SOME, THEIR BID MAY BE REJECTED. FOR A LIST OF YOUR VENDOR VIOLATIONS, YOU CAN FAX OR EMAIL THE LABOR CABINET WITH YOUR REQUEST. FAX NUMBER IS (502) 696-1984 OR EMAIL: wages@ky.gov. CONTRACTORS MUST ALLOW THREE (3) DAYS IN ORDER TO GET INFORMATION FROM THE LABOR CABINET.

THERE IS A CHECKLIST ON PAGE 4 OF THE OFFICIAL BID DOCUMENT FOR CONTRACTORS TO MAKE SURE ALL OF BID DOCUMENT IS ENCLOSED WHEN SUBMITTING THEIR BID.

IMPORTANT: Please follow current state COVID guidelines for all Commonwealth of Kentucky construction projects. All information and/or instructions will be in the Notice to Contractors and Advertisement for Bids.

Contractors must load their Bid Documents under the corresponding RFB in MOVEit in order for it to be received. IF BID IS NOT UPLOADED IN THE CORRECT FOLDER IN MOVEIt, THE BID WILL BE DEEMED NON-RESPONSIVE. BID MUST BE LOADED IN ONE COMBINED PDF FILE WHICH SHALL INCLUDE YOUR BID BOND.







MOVEIT TRANSFER

https://ftp.ky.gov

This application is used for

Secure File Transfer: upload/download files with the FTP application and share the secure location with other registered MOVEit users with no size limit. NOTE: the retention of files on all MOVEit applications is 90 days unless otherwise requested.



Login. The log in is case sensitive.

Username: kyrfb

Password: Submitter2020

Unable to login -

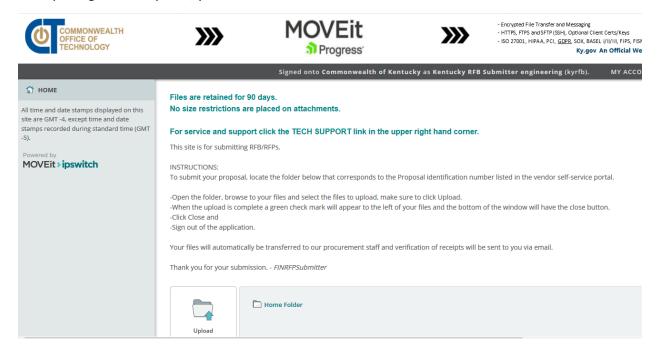
Contact the <u>CommonwealthServiceDesk@ky.gov</u> and they will notify the MOVEit team to assist you. You can also call 502-564-7576.

Forgot Password - YOU CANNOT CHANGE THE PASSWORD ON THIS ACCOUNT. DO NOT ATTEMPT TO CHANGE IT.

NOTE: You should not be prompted to change the password, if this occurs contact the Commonwealth buyer on the project.

IMPORTANT: Please include company name and RFB# in the file name. Contractors must load their Bid Documents COMBINED into one PDF document under the corresponding RFB in MOVEit in order for it to be received. IF BID IS NOT UPLOADED IN THE CORRECT FOLDER IN MOVEit, THE BID WILL BE DEEMED NON-RESPONSIVE.

After you login to the system, you will see this screen.



Notice the instructions on the screen for submission.

Scroll down to find the RFB/RFP you are submitting on. Open the folder by clicking on the folder with the correct RFB/RFP. Do **NOT** check the box. Click upload on the right side of the screen. Upload your proposal to the correct RFB/RFP.



Rev. 5/29/2020 Page **2** of **4**

** Highly Recommended **

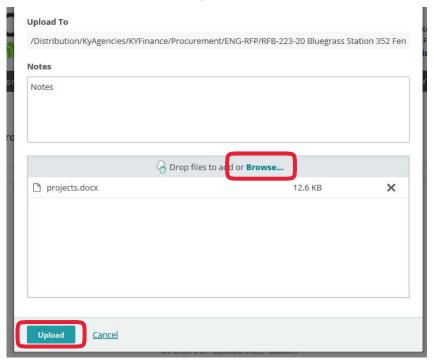
Before uploading your files, add your Company name to the front of all file names. Example: AcmeCoyote_Filename.pdf

NOTES Section – Use this section to input your contact information or make comments about the files being uploaded.

Browse to your files and select the files to upload - Do **NOT** use drag and drop.

Make sure to click Upload.

There is not a size limit for file uploads.

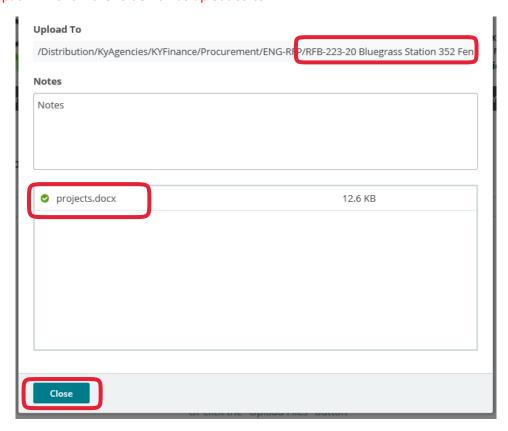


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When the upload is complete a check mark will appear to the left of your files and the bottom of the window will show the close button.

** We highly recommend that you print the screen as verification for your records that the file(s) were submitted. There is no other verification of receipt of files. If you feel that you need further verification, you can email COTMOVEitFTP@ky.gov or the buyer on the project.

Verify that the file was uploaded to the correct folder by reviewing the file path (see below). The last part of the path will show the folder it was uploaded to.



Click Close at the bottom of the window. Sign out.



The **Sign Out** Link will exit you from the application.

Your files will automatically be transferred to our procurement staff

The **Tech Support Link** will provide links to the User Guide under MOVEit Transfer Help, and Information on how to Contact the COT MOVEit Team.

FOR TECHNICAL ASSISTANCE WITH MOVEIT/FTP

- Non-Commonwealth third parties should contact the Commonwealth Service Desk. Commonwealthservicedesk@ky.gov and cc: COTMOVEITFTP@ky.gov. Or call 502-564-7576.
 - In the request for assistance please include the following -- username, telephone number, RFP number, list of any files you are uploading, and a detailed description of any errors or messages received.

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RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

This Official Bid Document consisting of pages 1 through 17, shall be used in submitting a bid document for the work. Copies will be furnished upon request by the authority issuing the Contract Documents.

| THIS BID DOCUMENT SUBMIT | ГЕD ВҮ | | |
|--|-----------|-------------------|-------|
| | (Name and | Address of Bidder | |
| DATE: | TEI | LEPHONE: | |
| GENTLEMEN: This Bidder, in compliance with your Request for Bid-No. RFB-132-22-and having carefully examined the Drawings and complete Contract Documents as defined in Article 1 of the General Conditions as well as the Specifications for the work as prepared by Ross Tarrant Architects, Inc.; hereby proposes to furnish all labor, the Emily supplies and services required to perform the specifics of the Contract Documents, within the time set forth therein and for the Artest Lumb Sum Bid Amount. The Bidder hereby acknowledges receipt of the following Asidendar. | | | |
| ADDENDUM NO | _ DATED_ | ADDENDUM NO | DATED |
| ADDENDUM NO | _ DATED | ADDENDUM NO | DATED |
| ADDENDUM NO | _ DATED | ADDENDUM NO | DATED |
| ADDENDUM NO | _ DATED | ADDENDUM NO | DATED |

(IF NONE HAVE BEEN ISSUED AND RECEIVED, INSERT THE WORD NONE.)

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

ALL BLANKS IN THE BID DOCUMENTS SHALL BE COMPLETED AND ALL REQUIRED SUPPORT DATA SHALL BE FURNISHED. IF INDICATED IN THE BIDDING DOCUMENTS, SUMS SHALL BE EXPRESSED IN BOTH WORDS AND FIGURES. IN THE CASE OF DESCREPANCY BETWEEN THE TWO, THE AMOUNT IN WORDS SHALL PREVAIL.

LUMP SUM BASE BID:

The Bidder agrees to furnish all labor, materials, supplies and services required to complete this project defined as RE-ADVERTISEMENT OF RFB-73-22, Student Center Building Renovation, Elizabethtown Community & Technical College, Elizabethtown, Kentucky for the Department for Facilities and Support Services, Commonwealth of Kentucky, in accordance with the Drawings, Specifications, and Contract Documents, and any duly issued Adderda for the LUMP SUM BID AMOUNT set forth below:

| LUMP SUM BASE BID AMOUNT: | | / _ | |
|--|--|---------------------------------------|---------------|
| | | 12Mpn | |
| | (0)_ & | | _DOLLARS |
| | A SE WORDS) | UND. | |
| | CEVARSE [ST.] | 200 | |
| (USE WORDS) | -22_V/4/All | (USE FIGURES) | |
| ADDITIVE ALTERNATE #1:, Terrace addition | on, including but not typiced to all struc | cture, railings, and new openings for | or storefront |
| systems. | | | |
| | 111100 | | |
| | (USE WORDS) | | _DOLLARS |
| | A | | |
| | CENTS (\$ | | |
| (USE WORDS) | | (USE FIGURES) | |

NOTE: THE AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST PAGE MUST BE PROPERLY EXECUTED FOR THE LUMP SUM BASE BID TO BE VALID.

ADDITIVE ALTERNATE #2: Fit-out of the Coding Academy classroom _DOLLARS (USE WORDS) CENTS (\$ (USE FIGURES) (USE WORDS) **ADDITIVE ALTERNATE #3:** Fit-out of the Transfer Office Suite. **DOLLARS** (USE WORDS) (USE FIGURES) (USE WORDS)

 $\underline{\text{NOTE:}}$ THE AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST PAGE $\underline{\text{MUST}}$ BE PROPERLY EXECUTED FOR THE LUMP SUM BASE BID TO BE VALID.

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OFFICIAL BID DOCUMENT

AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST

I, HEREBY CERTIFY:

- 1. That I am the bidder (if the bidder is an individual), a partner in the bidder (if the bidder is a partnership), or an officer and employee of the bidding corporation having authority to sign on it's behalf (if the bidder is a corporation);
- 2. That the submitted bid or bids covering Division of Engineering and Contract Administration Request for Bid No. RFB-122-22 have been arrived at by the bidder independently and have been submitted without collusion with, and without any agreement, understanding or planned common course of action with any other contractor, vendor of materials, supplies, equipment or services described in the Request for Bid, designed to limit independent bidding or competition; as prohibited by provision KRS 45A.325;
- 3. That the contents of the bid or bids have not been communicated by the bidder or its employees or agents to any person not an employee or agent of the bidder, its surety on any bond furnished with the bid or bids and will not be communicated to any such person prior to the official opening of the bid or bids.
- 4. That the bidder is legally entitled to enter into the contract with the Commonwealth of Kentucky and is not in violation of any prohibited conflict of interest, including those prohibited by the provisions of KRS 164.390; and 45A.330 to 45A.340 and 45A.455;
- 5. This offer is for thirty (30) calendar days from the date this brd is opened. In submiring the above it is expressly agreed that upon proper acceptance by the Division of Engineering and Contract Administration of any or all items bid above, a contract shall thereby be created with respect to the items accepted;
- 6. That I have fully informed myself regarding and affirm the accuracy of all statements made in this Official Bid Document including Bid Amount.
- 7. Unless otherwise exempted by KRS 45.590, the bidder intends to comply in full with all requirements of the Kentucky Civil Rights Act and to submit data required by the Kentucky Equal Employment Act upon being designated the successful bidder.
- 8. That the bidder, if awarded a contract, would not be in Malarion of the Executive Branch Code of Ethics established by KRS 11A.001 through KRS 11A-990.
- 9. That the bidder is not debarred from doing business with federal agencies and that, if debarred during the life of the contract, the bidder will notify the Commonwealth buyer of record within seventy-two (72) hours of the federal debarment.

READ CAREFULLY - SIGN IN SPACE BELOW - FAMURE TO SIGN INVALIDATES BID

| SIGNED BY: | FIRM: | |
|--|----------------------------------|----------|
| PRINT NAME: | ADDRESS: | |
| TITLE: | | |
| | CITY STATE | ZIP CODE |
| DATE: | TELEPHONE NO: | |
| FEDERAL ID. NO. OR SOCIAL SECURITY NO. | EMAIL: | |
| | rs, check type of certification: |] |

^{*}Disadvantaged Contractors attach a copy of certification.

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OFFICIAL BID DOCUMENT - SUBMITTAL DATA

THE FOLLOWING ITEMS ARE HEREWITH ENCLOSED AS REQUIRED:

| Sworn Required Affidavit For Bidders, Offerors And Contractors |
|---|
| Sworn Affidavit for Claiming Resident Bidder Status |
| Vendor Report of Prior Violations of KRS Chapters, 136, 139, 141, 337, 338, 341 and 342. |
| Bidder's Qualifications. |
| Disadvantaged Business Enterprises (DBE) Participation |
| The utilization of minority/disadvantaged vendors and subcontractors is encouraged, whenever possible, on public projects. The bidder and contractor should make full efforts to locate disadvantaged business persons. Bidders may use the following resources: Commonwealth of Kentucky's SMALL BUSINESS CONNECTION website: https://secure.kentucky.gov/sbc/default.aspx Kentucky Minority and Women Business Enterprise website: https://mwbe.ky.gov/Pages/default.aspx Kentucky Service-Disabled Veteran-Owned Small Business website: |
| https://finance.ky.gov/initiatives/sdvosb/Pages/default.aspx |
| Kentucky Transportation Cabinet Disadvantaged Business Enterprise directories: http://transportation.ky.gov/Civil-Rights-and-Small-Business-Development/Pages/Certified-DBE-Directory.aspx Finance and Administration Cabinet, Office of EEO/Contract Compliance: small finance.ContractCompliance@ky.gov or |
| call 502-564-2874 |
| LLS Small Pucinose Administration Dynamic Small Pucinote Sparch without the the gov/debe/sparch/dep. debe of m |
| U.S. Small Business Administration, Dynamic Small Business Search website: http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm Louisville/ Jefferson County Metropolitan Sewer District website: http://www.msdlopky.org/insidemsd/diverse/find.html |
| A bidder must include a list of all disadvantaged vendors and/or subcontractors contacted in order to prepare a bid (ATTACH |
| TO OFFICIAL BID DOCUMENT). |
| If the bidder fails to utilize any disadvantaged vehdors and/or subcontraction, a statement must be included to describe actions to include disadvantaged vendors and/or subcontractors (ATTACH TO OFFICIAL BID DOCUMENT). |
| The Finance and Administration Cabinet will review all submissions by bridgers to determine compliance with this provision. |
| List of Unit Prices, if applicable |
| List of Subcontractors, if applicable |
| List of Materials and Equipment, if applicable |
| Bid Guaranty in the amount of no less than five percent (5%) of the TOTAL BID AMOUNT. |
| Roofing Certifications, if applicable |
| COMMONWEALTH OF KENTUCKY |
| FINANCE AND ADMINISTRATION CABINET |
| SWORN STATEMENT REGARDING CAMPAIGN FINANCE LAWS |
| PURSUANT TO KRS 45A.110 AND KRS 45A.115 |

The following form (page 5) relative to Campaign Finance Laws shall be completed in total, notarized and returned with your bid. Responsibility of a bidder or offeror for a contract award shall not be made until the bidder or offeror provides this sworn statement.

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ANNUAL REQUIRED AFFIDAVIT FOR BIDDERS, OFFERORS AND CONTRACTORS

Page 1 of 2

| Affidavit Effective Date: | |
|-----------------------------------|--------------|
| Affidavit Expiration Date: | |
| Maximum Len | gth One-Year |

FOR BIDS AND CONTRACTS IN GENERAL:

- I. Each bidder or offeror swears and affirms under penalty of perjury, that to the best of their knowledge:
 - a. In accordance with KRS 45A.110 and KRS 45A.115, neither the bidder or offeror as defined in KRS 45A.070(6), nor the entity which he/she represents, has knowingly violated any provisions of the campaign finance laws of the Commonwealth of Kentucky; and the award of a contract to the bidder or offeror or the entity which he/she represents will not violate any provisions of the campaign finance laws of the Commonwealth.
 - b. The bidder or offeror swears and affirms under penalty of perjury that, to the extent required by Kentucky law, the entity bidding, and all subcontractors therein, are aware of the requirements and penalties outlined in KRS 45A.485; have properly disclosed all information required by this statute; and will continue to comply with such requirements for the duration of any contract awarded.
 - c. The bidder or offeror swears and affirms under penalty of perjury that, to the extent required by Kentucky law, the entity bidding, and its affiliates, are duly registered with the Kentucky Department of Revenue to collect and remit the sales and use tax imposed by KRS Chapter 139, and will remain registered for the duration of any source; awarded.
 - d. The bidder or offeror swears and affirms under penalty of penjury that the entiry triding is not delinquent on any state taxes or fees owed to the Commonwealth of Kentucky and will remain in good stanting for the duration of any contract awarded.
 - e. The bidder or offeror swears and affirms under penalty of perjury that the entity hadding, is not currently engaged in, and will not for the duration of the contract engage in, the boy cott of a person of an entity based in or doing business with a jurisdiction with which Kentucky can enjoy open trade, as defined in KRS 45 A 607.
 - f. The bidder or offeror swears and affirms that the entity bidding, and all subcontractors therein, have not violated any of the prohibitions set forth in KRS 11A.236 during the previous ten (10) years, and further pledge to abide by the restrictions set forth in such statute for the duration of the contract availed.

FOR "NON-BID" CONTRACTS (I.E.) SOLE-SOURCE, NOT-PRACTICAL OR FEASIBLE TO BID; OR EMERGENCY CONTRACTS, ETC):

- I. Each contractor further swears and affirms under penalty of perjury, that to the best of their knowledge:
 - a. In accordance with KRS 121.056, and it it is a non-bid contract, neither the contractor, nor any member of his/her immediate family having an interest of 10% or more in any business entity involved in the performance of any contract awarded, have contributed more than the amount specified in KRS 121.150 to the campaign of the gubernatorial slate elected in the election last preceding the date of contract award.
 - b. In accordance with KRS 121.330(1) and (2), and if this is a non-bid contract, neither the contractor, nor officers or employees of the contractor or any entity affiliated with the contractor, nor the spouses of officers or employees of the contractor or any entity affiliated with the contractor, have knowingly contributed more than \$5,000 in aggregate to the campaign of a candidate elected in the election last preceding the date of contract award that has jurisdiction over this contract award.
 - c. In accordance with KRS 121.330(3) and (4), and if this is a non-bid contract, to the best of his/her knowledge, neither the contractor, nor any member of his/her immediate family, his/her employer, or his/her employees, or any entity affiliated with any of these entities or individuals, have directly solicited contributions in excess of \$30,000 in the aggregate for the campaign of a candidate elected in the election last preceding the date of contract award that has jurisdiction over this contract.

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ANNUAL REQUIRED AFFIDAVIT FOR BIDDERS, OFFERORS AND CONTRACTORS

Page 2 of 2

As a duly authorized representative for the bidder, offeror, or contractor, I have fully informed myself regarding the accuracy of all statements made in this affidavit, and acknowledge that the Commonwealth is reasonably relying upon these statements, in making a decision for contract award and any failure to accurately disclose such information may result in contract termination, repayment of funds and other available remedies under law. If the bidder, offeror, or contractor becomes non-compliant with any statements during the affidavit effective period, I will notify the Finance and Administration Cabinet, Office of Procurement Services immediately. I understand that the Commonwealth retains the right to request an updated affidavit at any time.

| Signature | Printed Name |
|--|-------------------------------------|
| Title | Date |
| Company Name | $-\langle \langle \rangle_{\wedge}$ |
| Address | $\sim \sim \sim$ |
| | |
| Commonwealth of Kentucky Vendor Code (if known): | |
| Subscribed and sworn to before me by | -(a) Write) |
| of (Company Name) | s |
| | |
| Notary Public | |
| [seal of notary] | My commission expires: |

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REQUIRED AFFIDAVIT FOR BIDDERS, OFFERORS AND CONTRACTORS CLAIMING RESIDENT BIDDER STATUS

FOR BIDS AND CONTRACTS IN GENERAL:

The bidder or offeror hereby swears and affirms under penalty of perjury that, in accordance with KRS 45A.494(2), the entity bidding is an individual, partnership, association, corporation, or other business entity that, on the date the contract is first advertised or announced as available for bidding:

- 1. Is authorized to transact business in the Commonwealth;
- 2. Has for one year prior to and through the date of advertisement
 - a. Filed Kentucky income taxes;
 - b. Made payments to the Kentucky unemployment insurance fund established in KRS 341.49; and
 - c. Maintained a Kentucky workers' compensation policy in effect.

The BIDDING AGENCY reserves the right to request documentation supporting a bidder's claim of resident bidder status. Failure to provide such documentation upon request shall result in disqualification of the bidder or contract termination.

| Signature | Printed Name |
|-----------------------------------|------------------------|
| | |
| Title | Dine |
| Company Name | |
| Address | |
| | |
| | |
| Subscribed and sworn to before me | |
| \sim $^{\setminus}$ | (Affiant) (Title) |
| of (Company Name) | day of,20 |
| (Company Name) | |
| 37 (| |
| Notary Public | 1160/ 112 |
| | 1000 |
| [seal of notary] | My commission expires: |

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VENDOR REPORT OF PRIOR VIOLATIONS ON CONSTRUCTION SEALED BIDS

This form is applicable to all sealed bids for construction projects issued by the Finance and Administration Cabinet, Division of Engineering and Contract Administration (DECA) in accordance with KRS 45A.080.

The **Prime Bidder** on any construction sealed bid **shall** provide the required information attached, for the Prime Bidder, as **an attachment to the bid**.

The information required is specifically - any violations issued within the last five (5) calendar years of the following:

- 1. Violations of KRS Chapter 136 (Corporation and Utility Taxes);
- 1. Violations of KRS Chapter 139 (Sales and Use Taxes);
- 2. Violations of KRS Chapter 141 (Income Taxes);
- 3. Violations of KRS Chapter 337 (Wages and Hours);
- 4. Violations of KRS Chapter 338 (Occupational Safety and Health of Employees);
- 5. Violations of KRS Chapter 341 (Unemployment Insurance);
- 6. Violations of KRS Chapter 342 (Workers Compensation); and
- 7. Violations of Occupational Safety and Health Laws in any other states and at the federal level.

If there are no violations for a particular category, vendor should attach a statement to that effect.

VIOLATIONS, YOU CAN FAX OR EMAIL THE LABOR CABINET WITH YOUR REQUEST.

If there are violations for a particular category, the vendor should list them and provide the following information for each: the date of the violation, a short description of the violation (including statutory citation), the name of the powernmental enforcement agency involved, and the amount of any penalties imposed as a result of the fillal determination.

Please note that this information may be provided to other governmental agencies. Soci as the Kentucky Labor Cabinet, as part of the bid process. DECA reserves the unqualified right to disqualify any vendors from participating further in this bid process.

In addition, the successful prime bidder and subcontractors shall remain in contract compliance with KRS 45A.485 during the life of any contract awarded, and shall notify DECA of any new final determinations of violations in any of the above-mentioned categories, which occur after contract award, and during the life of any contract awarded. Enthuge to comply with these requirements may result in the bidder and subcontractors being disqualified from participating in facture bid opportunities for the Commonwealth.

| TAX PAYER ID #: | | CK/NN | | | |
|--------------------|----------------------|-----------------|---------------------|-----------------|-------------|
| | | | | | |
| THIS VENDOR VIOLAT | ΓΙΟΝ FORM MAY BE SEI | NT TO THE LABO | OR CABINET FOR VERI | FICATION. PLEAS | E MAKE SURE |
| ALL YOUR VIOLATIO | NS ISSUED WITHINGIA | E LAST FIVE (5) | YEARS ARE LISTED. | IF YOU LIST "NO | NE" BUT THE |
| LABOR CABINET'S RI | ECORDS SHOW OTHER | WISE. YOUR BIL | MAY BE REJECTED. 1 | FOR A LIST OF Y | OUR VENDOR |

FAX NUMBER IS (502) 696-1984 OR EMAIL: wages@ky.gov.

COMPANY NAME:

| Violation Category | Date | Description | Govt. Enforcement Agency | Amount of Penalties |
|--------------------|------|-------------|-----------------------------|---------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

BIDDER'S QUALIFICATIONS

| The Bidder's Qualifications are | e required by the | owner to be submitted as set | forth herewith: | |
|----------------------------------|-------------------|--------------------------------|---------------------|-------------------|
| This firm is a Corp, | Partnership | , or Proprietorship | · | |
| A permanent place of business | is maintained at: | | | |
| STREET | | CITY | STATE | ZIP CODE |
| TELEPHONE NUMBER | | | | |
| The following construction pla | nt and equipment | t will be made available for u | se on this contract | : |
| | | | ~02~ | |
| In the event the contract is awa | rded the undersig | gned sweets bonds will be fur | rurshed by |) |
| Experience of Contractor on ot | her similar work | | | |
| | | | 5 | |
| We now have the following job | os under sontract | and bonded: | | |
| JOB | 190 | TOTAL | CONTRACT | PERCENT COMPLETED |
| | | \$ | | % |
| | | \$ | | % |
| | | \$ | | % |
| | | \$ | | % |
| | | \$ | | % |

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DISADVANTAGED BUSINESS ENTERPRISE (DBE) PARTICIPATION

- 1.01 **CERTIFICATION OF DBE:** Any DBE utilized pursuant to this Section shall be certified as a DBE by one of the following: Kentucky Finance and Administration Cabinet, Kentucky Transportation Cabinet or other state Transportation agencies, the Louisville/Jefferson County Metropolitan Sewer District, the Tri-State Minority Supplier Development Council or other state Minority Supplier Development Councils, the Ohio River Valley Women's Business Council, the Women's Business Enterprise National Council, the National Women Business Owners Council, or the Small Business Administration.
- 1.02 **OBLIGATION OF BIDDER/CONTRACTOR:** Bidder/Contractor shall make a good faith effort to meet the DBE contract goal set by the Commonwealth by including DBE's as subcontractors and/or material suppliers on 10% of the total estimated cost of the Contract. The failure to meet the foregoing goal shall not result in disqualification from bidding or being awarded a contract. However, Bidders/Contractors not meeting the DBE goal shall be expected to provide written proof of their good faith efforts. Award of the contract shall be conditioned upon satisfaction of the requirements established by this section. The Bidder/Contractor shall attempt to divide the work in the contract to facilitate use of DBE's (however, there is no requirement that the work be artificially divided or divided in a way that raises the bid price of the Bidder/Contractor).
- 1.03 **PROOF REQUIRED:** Each bidder shall furnish written proof in their bid package that they reached the DBE participation goal for this Contract, or of their good faith efforts to meet the DRH participation goal. A copy of each participating DBE's certification shall accompany the required forms. All submissions shall be subject to verification of the Commonwealth.
 - Proof that the apparent successful bidder reached the DBE A. nsist of the following and shall be made on form DB-2-A, attached hereto:
 - The names and addresses of DBE firms that will participate in the contract; A description of the work each name DBE strat will perform; 1.
 - 2.
 - 3. The dollar amount of participation by each maned DBE firm;
 - The percentage amount of perticipation by 4. each named DBE firm;
 - Proof that the apparent B. a good faith efforts to meet the DBE participation goal may include the following:
 - e Bidder/Contractor of DBE contracting opportunities associated with this 1. least one of each of the following periodicals: a periodical in general circulation throughout the Commonwealth, a trade periodical focused on DBE contractors/suppliers in general circination throughout the Commonwealth, and a minority-focused periodical in general circulation throughout the Commonwealth. The Bidder/Contractor shall include copies of the dated advertisements in his bid package;
 - 2. Written notice of DBE opportunities in this contract to at least five pertinent DBE's at least seven days prior to the bid opening date. Copies of the written notices shall be included in the bid package;
 - 3. The Bidder/Contractor's response(s) to those DBE's who requested plans, specifications and/or contracting requirements. Copies of said responses shall be included in the bid package;
 - Documentation on form DB-2-B of good faith negotiations with at least three DBE's, with no 4. rejection of a qualified DBE without sound reason, including price quotes that are above other subcontractor's price quotes;
 - 5. Utilization of the Finance and Administration Cabinet's Office of Equal Employment Opportunity and Contract Compliance for referrals to organizations that assist in locating DBE's. Proof of use of such referrals and contacts made as a result thereof shall be included in the bid package.

DISADVANTAGED BUSINESS AVAILABILITY VERIFICATION

| | does commit itself the | at on the following project: |
|---|---|---|
| NAME OF COMPANY | | |
| PROJECT NAME | REQUEST FOR BID NUMBER | |
| The Bidder agrees to furnish information require intends to utilize. Breach of this commitment co | | |
| NAME OF DISADVANTAGED BUSINESS | TELEPHONE | TYPE OF WORK |
| | |) |
| DOLLAR VALUE | PERCENT | VANTAGED CLASSIFICATION |
| | | X |
| | | |
| The undersigned shall enter into a formal agreen conditioned upon execution of a contract with the Disadvantaged business firms listed above by the work for which they were proposed and accepted Architect/Engineer. The undersigned hereby car the Bidder to the commitment herein set forth Signature and title of authorized official of the codeemed nonresponsive. | e Commonwealth of Centucky. e Biddek and accepted by the Owner and the Arc Land shall not be changed except with the writte thes that he or she has read the terms of this con | chitect/Engineer shall be used on the en approval of the Owner and the mmitment and is authorized to bind |
| NAME OF AUTHORIZED OFFICER | TITLE | |
| SIGNATURE | DATE | |
| If you are bidding as a General Contractor on thi copy of your DBE Certification. | s project i.e. direct bidding and a Disadvantaged | as defined herein, please provide a |
| Submit with Bid. (Please copy additional Disadvantaged Business | Availability Forms as necessary.) | |

DB-2-B

DISADVANTAGED BUSINESS UNAVAILABILITY VERIFICATION

| , | | |
|--|---------------------------------|--|
| | | (TITLE) |
| C | | |
| of(PRIM | ME BIDDER) | |
| (TAI) | VIL BIDDER) | |
| ertify that on I contacted the formula in the person to obtain a bid for work items to be performed in the person to be perform | ollowing Disadvantaged of | owned business by: (circle one) Certified Mail, |
| Phone, In Person to obtain a bid for work items to be perform | rmed on the Contract. | |
| DISADVANTAGED | | FORM OF BID SUPPORT |
| CLASSIFICATION | WORK ITEMS | (I.E., UNIT PRICE, MATERIALS |
| IE. WBE, MBE, DBE, SDVOSB) CONTRACTOR | SOUGHT | LABOR & LABOR ONLY) |
| EL WELL, MELL, EEL, OF CONTRICTOR | | ENDOR & ENDOR ONET) |
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| o the best of my knowledge and belief, said Disadvantage | d own <u>ed</u> business was un | available (exclusive of unavailability due to lack |
| To the best of my knowledge and belief, said Disadvantage of agreement on price) for work on this project, or unable to | o prepare a bid, for the fol | Lowing reason(s); |
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| | <u>/</u> | was offered an |
| (NAME QE DISADV) | NTAGED BUSINESS) | |
| | | |
| pportunity to bid on the above-identified work on | | by |
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| IO2) | JRCE) | |
| (300 | (RCE) | |
| The above statement is a true and accurate account of why | I did not submit a bid on t | this project |
| and and a decount of why | 2 313 Hot bacillit a bla Oli (| mm broleen |
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| | (SIGNATUF | RE OF DISADVANTAGED BUSINESS) |
| | (SIGNATUF | RE OF DISADVANTAGED BUSINESS) |
| | (SIGNATUE) | RE OF DISADVANTAGED BUSINESS) (DATE) |

Submit with Bid if Applicable.

(Please copy additional Disadvantaged Business Unavailability Forms as needed.)

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OFFICIAL BID DOCUMENT FOR

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

LIST OF UNIT PRICES: (ALL BLANKS MUST BE FILLED IN)

Unit prices shall include the furnishing of all labor, materials, suppliers, services and shall include all items of cost, overhead and profit for the Contractor and any Subcontractor involved, and shall be used uniformly without modification for either additions or deductions. The Unit Prices as established shall be used to determine the equitable adjustment of the Contract Price in connection with changes or extra work performed under the Contract. Failure to completely fill out all unit prices requested may result in bid rejection.

| | DESCRIPTION OF WORK | ✓ UNIT PRICE | UNIT OF MEASURE |
|----|--|-----------------|--------------------|
| 1. | Terrazzo (TR2) Patch and Repair | s < | SF |
| 2. | Earthwork: Trench Earth Excavation and off-site disposal | * | CY |
| 3. | DGA, Installed and Compacted | | CY |
| 4. | 4" depth concrete pavement and aggregate base | | CY |
| 5. | 4" perf PE Pipe, Installed with 3-foot bury | 2 - 2 / 19/1/2, | LF |
| | | | |

OFFICIAL BID DOCUMENT FOR

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

LIST OF PROPOSED SUBCONTRACTORS:

(Must be submitted with Bid)

The following list of proposed subcontractors is <u>required by the owner</u> to be executed, completed, and submitted with the Bidder's <u>Proposal</u>. All subcontractors are subject to approval by the Division of Engineering and Contract Administration, Department of Facilities and Support Services, Frankfort, Kentucky. Failure to submit this list, completely filled out, may result in bid rejection.

If certain branches of work are to be done by the Prime Contractor, so state. Review/evaluation of subcontractors will occur on the bid opening day. If the Commonwealth requests replacement of a subcontractor, on bid opening day, then the apparent low bidder will provide a replacement subcontractor prior to close of the Commonwealth's business day on that day. Failure of the apparent low bidder to comply with the preceding sentence may result in bid rejection. If subcontractor review/evaluation is <u>not</u> completed on the bid opening day, then procedures for any replacement will be issued based on the uniqueness of each situation. The responsibility for selection, offering of qualified, competent subcontractors to accomplish the work intended is solely the responsibility of the bidder to the Commonwealth.

ALL BLANKS MUST BE FILLED IN. IF PERFORMED BY THE BIDDER, STATE PRIME/GENRAL CONTRACTOR.

| | BRANCH OF WORK | NAME OF SUBCONTRACTOR |
|-----|--|---|
| - | | 1 ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ |
| | | |
| 1. | Terrazzo (TR2) Patch and Repair | |
| | | 15 401 10 10. |
| 2. | Doors and Windows | \ \\\(\langle \)\\\(\langle \)\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\ |
| ۷. | Doors and windows | V 13/7/1/2 |
| | () ひんご | "C3/0 // 2 |
| 3. | Concrete | |
| | $(\mathscr{C} \cap V) \wedge$ | 11/1/63/ |
| 4. | Steel | (9)- |
| | | |
| 5. | Masonry | <u> </u> |
| | | |
| 6 | Dhumbing | 100 |
| 6. | Plumbing | |
| | ~~ | |
| 7. | Fire Protection | |
| | | |
| 8. | HVAC | |
| | | |
| 9. | HVAC Controls | |
| 2. | II VAC COMUUS | |
| 4.0 | AVI G. J. G. | |
| 10. | Niagara AX Certified Technician | |
| | | |
| 11. | Electrical | |
| | | |
| 12. | Roofing | |
| | • • • | |
| 12 | Elevator | |
| 13. | Elevator | |

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OFFICIAL BID DOCUMENT FOR

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

LIST OF MATERIALS AND EQUIPMENT (MUST BE COMPLETELY FILLED OUT WHEN BID IS SUBMITTED):

Every item listed under the different phases of construction must be clearly identified so that the Owner will definitely know what the bidder proposes to furnish. Bidders be hereby advised that this list is <u>required by the owner</u> to be executed, completed, and submitted with the Bidder's <u>Proposal</u>.

The use of the manufacturer's dealer's name only, or stating "as per plans and specifications", will not be considered as sufficient identification.

Where more than one "Make or Brand" is listed for any one item, the Owner has the right to select the one to be used.

Failure to submit a proper list may result in rejection of Bidder's Proposal.

| | MATERIAL AND/OR EQUIPMENT: | MANUFACTURER AND BRAND NAME: |
|-----|--|--|
| | | ⟨ |
| | | |
| 1 | T (TDO) D (1 1 D) | |
| 1. | Terrazzo (TR2) Patch and Repair | |
| | <i>/</i> \ | ("(LY) / () |
| 2. | Steel Fabricator | |
| | | 1 College |
| | | $V \wedge {}^{\prime\prime} C / \rho f / \rho f \rangle_{\Lambda}$ |
| 3. | Elevator | |
| | | $(\nabla L)/L/L$ |
| 4. | Aluminum Storefront Windows | (C)(O)(C) |
| | /7 \ / ° < | |
| _ | | 1111631 |
| 5. | Exterior Glazing | 1/2/- |
| | | M |
| 6. | Air Cooled Chiller | 1/2 |
| | | |
| 7 | WAGE " | |
| 7. | HVAC Boiler | |
| | (1) (1) (1) (1) (1) (1) (1) (1) (1) (1) | |
| 8. | HVAC Pumps | |
| | • | |
| | D 1' / 10 / '1 A' 11 ' | |
| 9. | Dedicated Outside Air Unit | |
| | | |
| 10. | Fan Coil Units | |
| | | |
| , , | Kitchen Hood System (Hood, Fans, and Make-Up | |
| 11. | Air Unit) | |
| | | |
| 12. | Water Heater | |
| | | |
| 1.0 | ANT COS | |
| 13. | Water Softener | |

LIST OF MATERIALS & EQUIPMENT (cont.): (must be submitted with bid)

| 14. | Electrical Equipment | |
|-----|--|--|
| 15. | Fire Alarm System | |
| 16. | Light Fixtures (list each type on separate sheet) & Controls | |
| 17. | Data/Communication | |





Andy Beshear
GOVERNOR

FINANCE AND ADMINISTRATION CABINET DEPARTMENT FOR FACILITIES AND SUPPORT SERVICES OFFICE OF FACILITY DEVELOPMENT

AND EFFICIENCY

403 Wapping Street Frankfort, Kentucky 40601-3462 Phone: (502) 564-4467 Holly M. Johnson
SECRETARY

Sam Ruth
COMMISSIONER

Jennifer Linton

EXECUTIVE DIRECTOR

NOTICE TO CONTRACTORS FOR

RE-ADVERTISEMENT OF RFB-73-22 STUDENT CENTER BUILDING RENOVATION ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE ELIZABETHTOWN, KENTUCKY

Attached hereto is a copy of the "Advertisement for Bids" for furnishing all labor, equipment, appliances and materials necessary for RE-ADVERTISEMENT OF RFB-73-22, Student Center Building Renovation, Elizabethtown Community & Technical College, Elizabethtown, Kentucky.

SAME IS DESIGNATED AS:

REQUEST NO. Request for Bid No. RFB-122-22

BID ON: RE-ADVERTISEMENT OF RFB-73-22

STUDENT CENTER BUILDING RENOVATION

ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE

ELIZABETHTOWN, KENTUCKY

BID DATE: February 9, 2022

2:00 P.M., Eastern Time

Responsible Contractors who have proper experience, equipment and qualifications are invited to bid on this work. These factors will be considered in the Award of Contract and all work will be performed under the standard regulations for construction of the Commonwealth of Kentucky.

SITE VISIT & VIRTUAL PREBID INFORMATION:

There will be a site visit for this project on January 24, 2022 at 10:00 AM, Eastern Time. Meet at the Student Center Lobby, Elizabethtown Community & Technical College, Elizabethtown, Kentucky. Interested contractors are encouraged to attend.

There will be a virtual pre-bid meeting on this project. The virtual prebid meeting will be held on January 28, 2022 at 9:00 AM, Eastern Time. Interested contractors must contact Michael Neureither with Ross Tarrant via email mneureither@rosstarrant.com to receive an invitation to this meeting.

ALL PROCUREMENT QUESTIONS SHALL BE DIRECTED TO BUYER OF RECORD FOR THIS PROJECT. IMPORTANT: SEE LAST PAGE OF ADVERTISEMENT FOR ANY COVID RELATED INFORMATION.



PART I ADVERTISEMENT FOR BIDS

1. **INVITATION**:

Sealed bid documents for the following work will be received by the Division of Engineering and Contract Administration. Bids will be received through MOVEit as described in the manner and on the date hereinafter specified for the furnishing of all labor, materials, supplies, tools, appliances, equipment, services, etc., necessary for RE-ADVERTISEMENT OF RFB-73-22, Student Center Building Renovation, Elizabethtown Community & Technical College, Elizabethtown, Kentucky, as set forth in the specifications and as shown on the drawings prepared by Michael Neureither, Ross Tarrant Architects, Inc., Chris Keath, Staggs & Fisher Consulting Engineers, Inc., and approved by the Department for Facilities and Support Services of the Commonwealth of Kentucky and under the terms and conditions to this Request for Bid.

2. **PROJECT DESCRIPTION:**

This project consists of the renovation of the existing approximately 18,000 GSF Student Center. The existing space will be converted into updated restrooms, classroom, offices, commercial kitchen, dining room and other support spaces. A new elevator will be installed inside the existing building along with a new outdoor elevated patio and new openings in the exterior wall. Base bid will include new rooftop mechanical units and associated roof patching. Site work will include a new outdoor mechanical yard, paving, and other site improvements. The building will receive all new mechanical and electrical systems throughout. Fire sprinklers will be installed and plumbing revisions as necessary to support the new spaces.

3. **METHOD OF BIDDING:**

Bids will be received from Prime Contractors on a Lump Sum Bid Basis for the total project. All phases of work shall be bid to and through the Prime Contracting Firms. Bids shall be submitted in the manner herein described and on the official bid document form included with the conditions and specifications and shall be subject to all the conditions as set forth and described in the Bid Documents.

SPECIAL NOTE:

Bids shall be submitted on the Official Form supplied by the Division of Engineering and Contract Administration. Failure to comply with the foregoing requirements will be cause for invalidation of bid.

4. **METHOD OF AWARD:**

Award shall be issued on the lowest responsive bid by a responsible bidder. The Bid Document shall contain all qualifying requirements and forms. It is the intent of the Commonwealth of Kentucky to use all available funds. Alternates will be taken in the order listed as funds permit.

Bid is subject to Reciprocal preference for Kentucky resident bidders and Preferences for a Qualified Bidder or the Department of Corrections, Division of Prison Industries (KAR 200 5:410).

KRS 45A.490 Definitions for KRS 45A.490 to 45A.494.

As used in KRS 45A.490 to 45A.494:

- (1) "Contract" means any agreement of a public agency, including grants and orders, for the purchase or disposal of supplies, services, construction, or any other item; and
- (2) "Public agency" has the same meaning as in KRS 61.805.

KRS 45A.492 Legislative declarations.

The General Assembly declares:

- (1) A public purpose of the Commonwealth is served by providing preference to Kentucky residents in contracts by public agencies; and
- (2) Providing preference to Kentucky residents equalizes the competition with other states that provide preference to their residents.

KRS 45A.494 Reciprocal preference to be given by public agencies to resident bidders -- List of states -- Administrative regulations.

- (1) Prior to a contract being awarded to the lowest responsible and responsive bidder on a contract by a public agency, a resident bidder of the Commonwealth shall be given a preference against a nonresident bidder registered in any state that gives or requires a preference to bidders from that state. The preference shall be equal to the preference given or required by the state of the nonresident bidder.
- (2) A resident bidder is an individual, partnership, association, corporation, or other business entity that, on the date the contract is first advertised or announced as available for bidding:
 - (a) Is authorized to transact business in the Commonwealth; and
 - (b) Has for one (1) year prior to and through the date of the advertisement, filed Kentucky corporate income taxes, made payments to the Kentucky unemployment insurance fund established in KRS 341.490, and maintained a Kentucky workers' compensation policy in effect.
- (3) A nonresident bidder is an individual, partnership, association, corporation, or other business entity that does not meet the requirements of subsection (2) of this section.
- (4) If a procurement determination results in a tie between a resident bidder and a nonresident bidder, preference shall be given to the resident bidder.
- (5) This section shall apply to all contracts funded or controlled in whole or in part by a public agency.
- (6) The Finance and Administration Cabinet shall maintain a list of states that give to or require a preference for their own resident bidders, including details of the preference given to such bidders, to be used by public agencies in determining resident bidder preferences. The cabinet shall also promulgate administrative regulations in accordance with KRS Chapter 13A establishing the procedure by which the preferences required by this section shall be given.
- (7) The preference for resident bidders shall not be given if the preference conflicts with federal law.
- (8) Any public agency soliciting or advertising for bids for contracts shall make KRS 45A.490 to 45A.494 part of the solicitation or advertisement for bids.

The reciprocal preference as described in KRS 45A.490-494 above shall be applied in accordance with 200 KAR 5:400.

Determining the residency of a bidder for purposes of applying a reciprocal preference

Any individual, partnership, association, corporation, or other business entity claiming resident bidder status shall submit along with its response the attached Required Affidavit for Bidders, Offerors, and Contractors Claiming Resident Bidder Status. The BIDDING AGENCY reserves the right to request documentation supporting a bidder's claim of resident bidder status. Failure to provide such documentation upon request shall result in disqualification of the bidder or contract termination.

A nonresident bidder shall submit, along with its response, its certificate of authority to transact business in the Commonwealth as filed with the Commonwealth of Kentucky, Secretary of State. The location of the principal office identified therein shall be deemed the state of residency for that bidder. If the bidder is not required by law to obtain said certificate, the state of residency for that bidder shall be deemed to be that which is identified in its mailing address as provided in its bid.

5. **PROJECT CONTACTS:**

- 1. Architect: Michael Neureither, Ross Tarrant Architects, Inc., (859) 254-4018, mneureither@rosstarrant.com
- 2. Consultant: Chris Keath, Staggs & Fisher Consulting Engineers, Inc., (859) 271-3246, ckeath@sfengineering.com
- 3. Project Manager: Bill Novak, Division of Engineering and Contract Administration, (502) 382-8680, Bill.Novak@ky.gov
- 4. Agency: Andy Casebier, KCTCS, (859) 753-5406, andy.casebier@kctcs.edu
- 5. Site: Carla Hammonds or Cody Warren, Elizabethtown Community & Technical College, 270-706-8606, carla.hammonds@kctcs.edu cwarren0043@kctcs.edu
- 6. Purchasing Agent: Kristi Sharp, CPPB, Division of Engineering and Contract Administration, (502) 330-9858, Kristi.Sharp@kv.gov

6. **BID SUBMITTAL:**

Bids will no longer be accepted via postal carrier (USPS, UPS, FED EX, etc.) nor can bids be delivered to the Bush Building. All forms in your bid document shall be completely filled out when your bid is submitted. Bids must be submitted electronically through MOVEit in order to be accepted. Instructions are attached. Contractors must load their Bid Documents COMBINED into one PDF document under the corresponding RFB in MOVEit in order for it to be received. IF BID IS NOT UPLOADED IN THE CORRECT FOLDER IN

MOVEit, THE BID WILL BE DEEMED NON-RESPONSIVE. Bidders are encouraged to take a screen shot verifying bid submittal. This is a secure website, no one can see these bids but the buyers. They are date and time stamped when submitted.

Please note that the instructions for MOVEit state that contractors will be notified when their bid is received. Buyers will NOT be notifying contractors.

All results will be posted to Lynn Imaging planroom after the bid opening and review. If additional information is needed from the successful bidder the buyer will be in contact.

NOTE: Your bid must be uploaded prior to the bid closing date and time. THE UPLOAD TIME MAY VARY DUE TO THE SIZE OF YOUR BID/PROPOSAL AND/OR INTERNET SPEED. NO LATE BIDS WILL BE ACCEPTED.

Bidder assumes full responsibility for timely delivery of the bid in compliance with the above described procedures and conditions.

There will be a public bid reading by conference call on the bid opening date at 2:30 PM ET. The dial in number is 502-782-2663 or 844-603-5060. Participant code is 801454#

7. **BID WITHDRAWAL:**

No bidder may withdraw his bid for a period of thirty (30) days after the date set for the opening of bids.

8. **BONDING:**

All bids shall be accompanied by a bid guarantee (in the form of a bid bond or certified check) of not less than five (5%) percent of the amount of the lump sum base bid. A 100% Performance Bond and a separate 100% Payment Bond shall be furnished by the successful bidder. All bonding and insurance requirements are contained in the Instructions to Bidders and/or General Conditions. Bonds should be executed by a surety company authorized to do business in the Commonwealth of Kentucky.

9. **RIGHT TO REJECT:**

The Division of Engineering and Contract Administration, Commonwealth of Kentucky, reserves the right to reject any and all bids and to waive all informalities and/or technicalities where the best interest of the Commonwealth may be served.

10. **GENERAL INFORMATION:**

- A. Bidder's Qualifications, Unit Prices, Proposed Subcontractors, and List of Materials are required to be submitted with the bid.
- B. All documents related to this project shall be submitted, transmitted, transferred, reviewed, approved or rejected, and/or otherwise processed using the Owner's Document Collaboration System (eCommunications) which is the Owner's web-based document collaboration system that shall be used by all project participants. No submission, transmittal, transfer, review, approval or processing shall be deemed Official without the use of this system. All additions or deletions of employees to their ecomm vendor record will be the responsibility of the contractor.
- C. KRS 337.550 (1) Provides that if any contractor or subcontractor is found to be in violation of any provisions of KRS 337.505 to 337.550 by the Department of Labor and upon notification to the Commissioner of the Department for Facilities and Support Services, the Commissioner of the Department for Facilities and Support Services shall hold such contractor or subcontractor ineligible to bid on public works until such a time as that contractor or subcontractor is in substantial compliance as determined by the Commissioner of Labor.
- D. Each demolition/renovation project must comply with Kentucky Division of Air Pollution Control Regulation 401 KAR 57:011. This includes notification, in writing, to the Division of Air Pollution Control, ten (10) days before start of the project.

E. **Tobacco-Free:** Pursuant to Executive Order, use of any tobacco products (including e-cigarettes) is prohibited in all Executive Branch buildings and parking lots and on the grounds. Please refer to Executive Order # 2014-747 for complete details. For FAQ's go to: http://tobacco-free.ky.gov/Pages/FAQs.aspx

F. REGISTRATION WITH SECRETARY OF STATE:

Domestic and foreign corporations shall be registered with the Kentucky Secretary of State and declared to be in "good standing" prior to award of contract. Offeror should verify status at the following website: http://www.sos.ky.gov and click on "Business Services". Failure to comply with this requirement within (5) days after notification may render your bid non-responsive.

G. REGISTRATION WITH SECRETARY OF STATE BY A FOREIGN ENTITY:

Pursuant to KRS 45A.480(1)(b), an agency, department, office, or political subdivision of the Commonwealth of Kentucky shall not award a state contract to a person that is a foreign entity required by KRS 14A.9-010 to obtain a certificate of authority to transact business in the Commonwealth ("certificate") from the Secretary of State under KRS 14A.9-030 unless the person produces the certificate within fourteen (14) days of the bid or proposal opening. Therefore, foreign entities should submit a copy of their certificate with their solicitation response. If the foreign entity is not required to obtain a certificate as provided in KRS 14A.9-010, the foreign entity should identify the applicable exception in its solicitation response. Foreign entity is defined within KRS 14A.1-070.

For all foreign entities required to obtain a certificate of authority to transact business in the Commonwealth, if a copy of the certificate is not received by the contracting agency within the time frame identified above, the foreign entity's solicitation response shall be deemed non-responsive or the awarded contract shall be cancelled.

Businesses can register with the Secretary of State at https://secure.kentucky.gov/sos/ftbr/welcome.aspx.

H. REGISTRATION with eMars (eProcurement):

In order to receive a contract in the State's electronic procurement system (eMars/eProcurement), a vendor/contractor shall be registered to conduct business therein. Business entities not already registered may register by visiting the eProcurement website at https://finance.ky.gov/eprocurement/pages/default.aspx and complete the registration information. The website has phone numbers and email addresses to facilitate answering any questions you may have with the registration or update process. Failure to comply with this requirement within (5) days after notification may render your bid non-responsive.

I. <u>SITE VISIT & VIRTUAL PREBID INFORMATION:</u>

There will be a site visit for this project on January 24, 2022 at 10:00 AM, Eastern Time. Meet at the Student Center Lobby, Elizabethtown Community & Technical College, Elizabethtown, Kentucky. Interested contractors are encouraged to attend.

There will be a virtual pre-bid meeting on this project. The virtual prebid meeting will be held on January 28, 2022 at 9:00 AM, Eastern Time. Interested contractors must contact Michael Neureither with Ross Tarrant via email mneureither@rosstarrant.com to receive an invitation to this meeting.

ALL PROCUREMENT QUESTIONS SHALL BE DIRECTED TO BUYER OF RECORD FOR THIS PROJECT.

Section 1: Definitions

- 1. "Addendum" means a written or graphic instrument issued by the purchasing agency prior to the execution of the contract that modifies or interprets the Bidding Documents by addition, deletion, clarification or correction.
- 2. "Alternate" means an optional item stated in the bid the amount of which is to be added to or deducted from the amount of the base bid.
- 3. "Architect" or "Engineer" means a firm that provides professional design services and is engaged by the Division of Engineering and Contract Administration for Capital Construction Projects, and identified as such in the Contract Documents. The term refers to the design team, consisting of the prime architect/engineer and all Sub-Consultants (if used) or consultant identified by the owner.
- 4. "Bid" means the sum stated in the Bid Response for which the bidder offers to perform the work described in the specifications and detailed on the plans.
- 5. "Bidder" means one who submits a bid directly to the owner for the work described in the bidding documents.
- 6. "Bidding Documents" means the Solicitation, including Instructions to Bidders, General Conditions, Special and Supplemental Conditions, Forms for Response, plans, specifications and Addenda issued prior to receipt of bids.
- 7. "Bid Response" means a complete and properly signed document, offering to do the work or designated portion thereof, supported by data called for by the bidding documents.
- 8. "Chief Purchasing Officer" means the secretary of the Finance and Administration Cabinet, who shall be responsible for all procurement of the Commonwealth except as provided by KRS Chapters 175, 176, 177, and 180. KRS 45A.030(3).
- 9. "Commonwealth" means the Commonwealth of Kentucky.
- 10. "Construction" means the process of building, altering, repairing, improving or demolishing any public structures or buildings, or other public improvements of any kind to any public real property. It does not include the routine maintenance of existing structures, buildings or real property. KRS 45A.030(4).
- 11. "Contract (CT/CT2)" means a document established to purchase a specific quantity or amount of goods or non-professional services at a specific price. KRS 45A.030(8).
- 12. "Contract Modification" means any written alteration in the specifications, delivery point, rate of delivery, contract period, price, quantity or other contract provisions of any existing contract, whether accomplished by unilateral action in accordance with a contract provision or by mutual action of the parties to the contract. It includes bilateral actions, such as supplemental agreements, and unilateral actions, such as change orders, administrative changes, notices of termination and notices of the exercise of a contract option. KRS 45A.030(9).
- 13. "DECA" means the Division of Engineering and Contract Administration within the Department for Facilities and Support Services, Finance and Administration Cabinet.
- 14. Delivery Order (DO/DO2)" means a document established by a state agency to purchase a specific quantity at a specific price referencing a Master Agreement. DO documents are generally used for commodities and DO2 documents are used for services.
- 15. "DFSS" means the Department for Facilities and Support Services within the Finance and Administration Cabinet.
- 16. "DRP" means the Division of Real Properties within the Department for Facilities and Support Services, Finance and Administration Cabinet.

- 17. "Electronic Offer" means an online bid through the state's eProcurement system, an offer submitted by electronic mail, or an offer submitted by facsimile.
- 18. "FAC" means the Finance and Administration Cabinet.
- 19. "Government Body" means any department, commission, council, board, bureau, committee, institution, legislative body, agency, government, corporation or other establishment of the executive or legislative branch of the state government. KRS 45A.030(17).
- 20. "Master Agreement (MA)" means a document that establishes a price agreement for use by state agencies with a vendor for supplying specific goods and services at specific unit prices during a specified time period. It does not place an order for goods and services.
- 21. "Offer" means a bid, proposal, Solicitation response or quotation.
- 22. "OPS" means the Office of Procurement Services within the Finance and Administration Cabinet.
- 23. "Owner" means the Commonwealth of Kentucky.
- 24. "Person" means any business, individual, organization or group of individuals. KRS 45A.030(20).
- 25. "Planholder" means any entity, supplier and/or subcontractor that has purchased plans and specifications from the Division of Engineering and Contract Administration's reprographics vendor in order to submit a bid with the Commonwealth of Kentucky.
- 26. "Procurement" means the purchasing, buying, renting, leasing or otherwise obtaining of any supplies, services or construction. It includes all functions that pertain to the procurement of any supply, service or construction item, including description of requirements, selection and solicitation of sources, preparation and award of contract, and all phases of contract administration. KRS 45A.030(21).
- 27. "Proof of Necessity Agreement (PON2)" means a type of contract established by a state agency to purchase professional services (i.e. personal service contracts, grants and memoranda of agreements).
- 28. "Purchase Order (PO/PO2)" means a type of contract established by a state agency to purchase a specific quantity or amount of goods or non-professional services at a specific price and is generally for a one-time purchase. A PO2 for non-professional services may contain an option to renew for an additional time period.
- 29. "Purchasing Agency" means any governmental body that is authorized by this code or its implementing administrative regulations or by way of delegation from the chief purchasing officer to contract on its own behalf rather than through the central contracting authority of the chief purchasing officer. KRS 45A.030(23).
- 30. "Purchasing Officer" means any person authorized by a governmental body in accordance with procedures prescribed by administrative regulations to enter into and administer contracts and make written determinations and findings with respect thereto. The term includes an authorized representative acting within the limits of authority. KRS 45A.030(24).
- 31. "Quote" or "Quotation Response" means a complete offer to perform the work specified in the Request for Quotation.
- 32. "RFB" means a Request for Bids.
- 33. "RFI" means a Request for Information.
- 34. "RFP" means a Request for Proposals. KRS 45A.070(5).
- 35. "RFQ" means a Request for Quotations.

- 36. "SAS" means the Office of Statewide Accounting Services within the Finance and Administration Cabinet.
- 37. "Secretary" means the secretary of the Finance and Administration Cabinet.
- 38. "Solicitation" means an RFB, RFI, RFP or RFQ.
- 39. "Sub-bidder" or "Subcontractor" means one who submits a bid to a prime bidder for materials or labor for a portion of the work described in the bidding documents.
- 40. "Tiered Pricing" means a determination of price based on volume, where the larger the volume, the larger the discount offered.
- 41. "Time" means calendar days.
- 42. "Unit Price" means an amount stated in the bid as a price per unit of measurement for materials or services as described in the bidding documents.
- 43. "Using Agency" means the state government entity that utilizes the work being contracted.

FAP 220-05-00 BIDDER INSTRUCTIONS FOR COMPETITIVELY SEALED BID CONSTRUCTION SOLICITATIONS

- 1. Bidder's Representations: Each bidder, by submitting a bid, swears or affirms, under penalty of law, that:
 - a. The bidder has read and understands the bidding documents and the bid is made in accordance with the bidding documents.
 - b. The bidder has carefully examined the site of the proposed work and is familiar with the local conditions under which the work is to be performed.
 - c. The bid is premised upon furnishing the work required by the bidding documents.
 - d. The bid amount has been arrived at by the bidder independently and has been submitted without collusion with, and without any agreement, understanding or planned common course of action with any other contractor, vendor of materials, supplies, equipment or services described in the Solicitation, that is designed to limit independent bidding or competition.
 - e. The contents of the bid have not been communicated by the bidder or its employees or agents to any person not an employee or agent of the bidder, or its surety on any bond furnished with the bid and will not be communicated to any such person prior to the bid opening.
 - f. The bidder is legally entitled to enter into a contract with the Commonwealth and the award of a contract shall not create any conflict of interest, including those set out in KRS 45A.330 KRS 45A.340; KRS 45A.455 and KRS 164.390.

2. Bidding Documents:

- a. A bidder, sub-bidder, sub-contractor and others may obtain bidding documents in the manner and for the charge, if any, stated in the Solicitation.
- b. A complete set of bidding documents shall be used in preparing bids. The Commonwealth assumes no responsibility for misinterpretations resulting from the use of incomplete sets of bidding documents. The bidder shall supply all information called for in the Solicitation. Failure to supply the specified information may be cause for determining the bid nonresponsive.
- c. The Commonwealth, in providing bidding documents, does so only for the purpose of obtaining bids on the work and does not confer a license or grant for any other use.
- d. A bidder shall promptly notify the purchasing officer of any ambiguity, inconsistency or error, which it may discover upon examination of the bidding documents or of the site and local conditions.
- e. All questions regarding the meaning or interpretation of the bidding documents shall be directed in writing to the purchasing officer. Unless otherwise specified in the Solicitation, questions received less than ten (10) calendar days prior to the date for receipt of bids may not be answered.
- f. Any interpretation, correction or change of the bidding documents shall be made by an addendum issued by the purchasing agency. Interpretations, corrections or changes of the bidding documents made in any other manner shall not be binding and bidders shall not rely upon such interpretations, corrections or changes.
- g. Unless otherwise indicated in the bidding documents, the materials, products and equipment described or referenced by manufacturers' or vendors' names, trade names and catalog numbers are intended to establish a standard of required function, dimension, appearance and quality. Unless otherwise stated, equal items may be furnished or used if approved by the purchasing officer in consultation with the architect or the director of DECA.

- h. Addenda shall be published on the Commonwealth's eProcurement web site, and shall be issued to all who are registered planholders with the contracted reprographics company or other distribution authorized by the director of DECA.
- i. Copies of addenda shall be made available for inspection wherever bidding documents are on file.
- j. No addenda of a material nature shall be issued later than seven (7) calendar days prior to the date for receipt of bids, except for addenda postponing the date for receipt of bids or withdrawing the Solicitation.
- k. The bidder shall ascertain prior to submitting a bid that the bidder has received all addenda issued by the purchasing officer for the particular solicitation. The bidder shall acknowledge receipt of all addenda on the Bid Response or by a separate letter to the purchasing officer, which shall be received at or prior to the hour and date specified for receipt of bids.

3. Bidding Procedure:

- a. Bids shall be submitted on the Bid Documents provided by the purchasing officer.
- b. All blanks in the Bid Documents shall be completed and all required support data shall be furnished.
- c. If required in the bidding documents, sums shall be expressed in both words and numerical figures. In the case of discrepancy between the two, the amount in words shall prevail.
- d. The authorized representative of the bidder, who signed the Bid Response, shall initial any alteration or erasure in ink.
- e. The bid shall be firm in offer and conform substantially to the advertised terms, plans and specifications. Any qualifications or reservation imposed by a bidder in the bid retaining the option of accepting, modifying or rejecting an offered contract shall be cause to render the bid not firm and ineligible for consideration of award. Any offer in response to the Solicitation that includes terms contrary or in addition to those in the Solicitation may be considered non-responsive and may be rejected by the Commonwealth.
- f. All alternates specifically called for by the Commonwealth shall be bid. Voluntary alternate bids or an alternate to a lump sum bid shall not be considered.
- g. The bidder shall make no stipulations on the Bid Response nor qualify the bid in any manner.
- h. A person legally authorized to bind the bidder to a contract shall sign the Bid Response. The Bid Response shall also include the legal name of the bidder and a statement indicating whether the bidder is a sole proprietorship, a partnership, a corporation or other legal entity. A bid by a corporation shall also identify the state of incorporation and federal employer identification number.
- i. The purchasing officer shall retain the bid security of bidders until:
 - 1. The contract has been executed and performance and payment bonds have been furnished;
 - 2. The specified time has elapsed so that bids may be withdrawn; or
 - 3. All bids have been rejected.
- j. The completed Bid Response, bid security, and required support data shall be enclosed in a sealed envelope. The envelope shall be addressed to the bid receipt clerk stated in the Solicitation and shall identify the bidder's name and address, the invitation number stated in the bidding documents, closing date and hour. If the bid is sent by mail, the sealed envelope shall contain the notation "BID ENCLOSED" on the face thereof.

- k. Bids shall be received at the designated location prior to the closing time and date for receipt of bids indicated in the Solicitation or any extension thereof made by addendum. Bids received after the closing time and date for receipt of bids may be considered for evaluation and award only if:
 - 1. No other bids were received within the advertisement period;
 - 2. The readvertisement time delay would seriously affect the operations of the using agency; and
 - 3. In the reasonable judgment of the purchasing officer, the bid was finalized prior to the official closing time and date for the receipt of bids.
- I. A bidder shall assume full responsibility for timely delivery at the location designated for receipt of bids.
- m. Oral, telephonic, facsimile or telegraphic bids or changes in bids by such methods are not permitted and shall not be considered.
- n. A competitively solicited contract shall be awarded from a bid evaluation in the state's eProcurement system or all bidders shall be notified of the award in writing.

4. Modification or Withdrawal of a Bid:

- a. A bid may be withdrawn prior to the closing time and date for receipt of bids by written request from an authorized representative of the bidder. The modification or withdrawal of a bid shall be received by the receipt clerk stated in the Solicitation prior to bid closing time to be considered valid.
- b. A withdrawn bid may be resubmitted up to the closing time designated for the receipt of bids.
- c. No bidder may withdraw, modify or cancel its bid for a period of thirty (30) calendar days following closing time and date for receipt of bids without the bid security being subject to forfeiture.

5. Legal Requirements:

- a. A foreign corporation submitting a bid shall be registered with the Kentucky Secretary of State and be declared in good standing prior to the issuance or receipt of a contract.
- b. A domestic corporation submitting a bid shall be in good standing in accordance with the requirements of the Kentucky Secretary of State.

6. Taxes:

- a. The winning bidder shall be liable for payment of Kentucky sales and use tax.
- b. The winning bidder is deemed the end user of all building materials used in construction projects for the Commonwealth.
- c. The winning bidder may not separately state Kentucky sales or use tax payable by the Commonwealth.
- 7. Planholder's List: The published planholder and addenda listing is for general information purposes and the exclusion or inclusion of any firm in no way expresses or implies Commonwealth approval or disapproval of the qualifications of any listed bidder, subcontractor, or material or equipment supplier.
- **8. Bid Bonds:** Pursuant to KRS 45A.185, DECA or the using agency may require a bid bond as surety that a bidder will hold its offer firm for a specified period of time. If the Solicitation requires a bid bond, a bidder shall file with the requesting agency a bid bond or certified check in the amount and form specified by the Solicitation with the requesting agency. The bond shall be received either with the bid or prior to the bid closing to be considered.

- a. The bond shall be in an amount equal to at least five percent (5%) of the amount of the bid or as stated in the Solicitation.
- b. In addition to signing the bid bond as principal, the bidder shall have the bond signed by a surety company authorized to do business in the Commonwealth. A list of surety companies may be obtained from the Kentucky Department of Insurance. If the surety on a bond has its authority to do business in Kentucky revoked or, if for any reason it ceases to do business in the Commonwealth, the bidder shall promptly obtain another surety on the bond.
- c. The bond shall be conditioned on full performance of all obligations imposed on the bidder by the Solicitation, including the obligation to keep the price firm for as long a period as specified in the Solicitation, obligation to enter into a contract with the Commonwealth, and the obligation to file a performance payment bond if required by contract. The bid bond shall provide that upon failure to perform an obligation, the Commonwealth may recover from the bidder and the surety, or either of them, any and all damages suffered because of the failure.
- d. If a bidder elects to submit a certified check in lieu of a bid bond, it shall be security for full performance of all obligations referred to in subsection c. of this Section.
- e. If a bidder is not awarded a contract, the certified check shall be returned to that bidder promptly after the award is made. The successful bidder's check shall be returned after the contract is awarded or as soon as the bidder has filed a performance bond, if required. Checks may be returned by certified mail, return receipt requested. The return receipts shall be electronically attached or hard copies attached to each bidder's bid and filed in the bid folder.

9. Consideration of Bids:

- a. Unless the bidding documents indicate otherwise, all properly identified, timely bids shall be publicly opened, read aloud, and listed on the official bid tabulation. Tabulations shall be made available to bidders upon written request to the FAC's Open Records Custodian.
- b. The Commonwealth retains the right to cancel the Solicitation, to reject any and all bids, and to waive technicalities and minor irregularities in bids, if such action is determined to be in the best interest of the Commonwealth.
- c. Grounds for the disqualification of bids are stated in 200 KAR 5:306(4)(2).
- d. Minor or technical deficiencies or irregularities in a bid may be waived by the purchasing officer on behalf of the Commonwealth, if:
 - 1. The purchasing officer determines that it is in the Commonwealth's best interest to do so;
 - 2. The technicalities or irregularities are mere matters of form not affecting the material substance of a bid, represent an immaterial deviation from or variation in the precise requirements of the Solicitation, and have no more than a trivial or negligible effect on price, quality, quantity or delivery of supplies or performance of services being procured; and
 - 3. The correction or waiver of the technicality or irregularity does not affect the relative standing of, or prejudice other bidders.
- e. If the Commonwealth does not waive the deficiency, the deficient bid shall be rejected.

10. Acceptance of Bid:

a. A contract shall be awarded, after a reasonable bid evaluation period, in accordance with the Solicitation, if the acceptable bid is within the amount budgeted by the agency.

b. The Commonwealth reserves the right to accept or reject any alternate bid. If alternates designated by the Commonwealth are considered in the award, the alternates shall be accepted in the sequence in which they are listed on the Bid Documents and the lowest bid sum shall be computed on the basis of the sum of the base bid plus any alternates accepted.

11. Qualification of Contractors:

- a. A bidder shall submit a statement of the bidder's qualifications as part of the Bid Response. The purchasing officer shall have the right to make such inquiry as deemed necessary to determine the ability of the bidder to perform the work in a prompt and efficient manner in accordance with the contract documents. The failure of a bidder to promptly supply information in connection with the purchasing officer's inquiry may be grounds for a determination that such bidder is nonresponsive.
- b. In determining the qualifications and responsibility of a bidder, the purchasing officer shall consider the bidder's experience, facility, previous work standing, financial standing, skill, quality and efficiency of construction plant, and equipment proposed to be utilized on the project.
- c. The Commonwealth may reject any bid if an investigation and evaluation of the bidder's qualifications give reasonable doubt that the bidder can perform the work in a prompt and efficient manner in accordance with the contract documents.

12. Unit Prices:

- a. If requested in the Solicitation, a bidder shall submit a list of unit prices in accordance with the Bid Document instructions, which shall include labor, materials, equipment, appliances, supplies, overhead and profit, as applicable.
- b. Unit prices shall be used for the pricing of changes in the quantity of work from that indicated by the contract drawings and specifications, if the Commonwealth has authorized such changes in writing.
- c. Only one (1) unit price shall be quoted for each designated item of work. The unit price shall be used to calculate price adjustments based on deductive as well as additive changes.
- d. Unit prices shall apply to all phases of the work whether the work is performed by the bidder or by the bidder's subcontractor.
- e. For unit prices of a lump sum bid contract, the Commonwealth reserves the right, prior to an award of contract, to evaluate the unit prices and adjust or reject any unit price that is determined by the purchasing officer to be unreasonable in amount.
- f. If a total sum bid is made by line item, and unit prices are quoted for estimated quantities of units of work, such unit prices are not subject to change. However, the purchasing officer reserves the right to correct mathematical errors in extensions and additions by the bidder. In the latter case, the purchasing officer's corrected bid sum total shall supersede the bidder's incorrect computed bid sum total.

13. Subcontractor Listing:

- a. If requested, a bidder shall list the names of subcontractors proposed for each of the principal portions of the work, including those persons or entities who are to furnish material or equipment fabricated to a special design, in the designated place on the Bid Documents.
- b. When a listed subcontractor is proposed for a principal portion of the work as required in subsection a. above, and that subcontractor is not self-performing the work, but is subcontracting the work to lower tier subcontractor, each lower tier subcontractor shall be listed in parenthesis after the name of the main subcontractor. Without such listing of lower tier contractors, the main subcontractor must perform the work of that principal portion of the work with its own forces in its entirety.

- c. A bidder shall establish, to the satisfaction of the purchasing officer, the reliability and responsibility of the listed subcontractors. The bidder may be required by the purchasing officer to provide additional information regarding listed subcontractors, including listed lower tier subcontractors.
- d. If, after due investigation, there is reasonable objection to the qualifications of a listed subcontractor or a listed lower tier subcontractor, the bidder shall, upon written direction of the purchasing officer, submit the name of an acceptable substitute subcontractor or lower tier subcontractor with no change in bid price. The failure of the bidder to promptly comply with this requirement may be grounds for rejection of the bid.
- e. Any listed subcontractor or listed lower tier subcontractor to whom the purchasing officer does not make written objection prior to the award of the contract shall be deemed acceptable to the Commonwealth.
- f. A bidder shall make no other substitution for any listed subcontractor or listed lower tier subcontractor without first receiving the approval of the purchasing officer in writing of the intended substitution and the specific reason for the substitution. A substitution may be disapproved if the purchasing officer has reasonable objection. The purchasing officer may require a written agreement from the subcontractor being released.
- g. Any work performed by a lower tier subcontractor that is not listed on the form of proposal in the manner described above, where required by the purchasing officer, shall be deemed to have been installed at the risk of the general contractor and the Commonwealth reserves the right, at its sole discretion, to reject that portion of the work and require that the work be removed and installed by a listed subcontractor or that the Commonwealth otherwise be compensated by a credit change order for an amount determined by the Commonwealth as reasonable for acceptance of such work installed by a non-listed lower tier subcontractor.
- h. Nothing contained in the bidding documents shall be deemed to create a contractual relationship between the Commonwealth and any subcontractor.

14. Materials and Contractor Listing:

- a. If requested, a bidder shall submit a listing of primary materials and equipment, including manufacturer's name, brand and catalog number. The materials and equipment listing shall be bound with the Bid Response or completed in the time period designated in Section 15.b. of this FAP.
- b. Prior to the final acceptance of a bid, the purchasing officer shall make a preliminary review of the bidder's list of materials and equipment. The purchasing officer shall advise the bidder of the tentative acceptability of such materials and equipment, subject to satisfactory completion and approval of shop drawings, or direct such other action as may be necessary in order to meet the requirements of the contract documents. If any of the listed material or equipment is determined not to meet the requirements of the contract documents, the bidder shall be required to furnish other material or equipment meeting those requirements at no change in bid price. Preliminary review and acceptance of the above list shall not relieve the bidder, as the contractor, of the obligation to furnishing equipment and materials in accordance with the contract documents.

15. Post-Bid Review:

- a. A bidder may have an authorized representative at the bid opening for the submittal of the material and equipment listing and the post-bid review of the apparent winning bid.
- b. Unless otherwise provided in the bidding documents or authorized by the purchasing officer, the apparent winning bidder shall submit the material and equipment listing no later than one (1) hour after the close of the reading of the bids. The materials and equipment listing shall be that listing bound with the Bid Documents.
- c. After opening, the scope of work bid by each bidder shall be reviewed by representatives of the purchasing agency, the using agency, the architect or engineer, and the apparent winning bidder. Review shall be directed toward subcontractors, material listing, unit prices and qualifications of the bidder.

d. The bidder's representative shall have the authority and ability to respond to questions that arise during the review.

16. Equal Employment and Nondiscrimination:

- a. The Commonwealth is committed to a policy of providing equal job opportunities on public contracts and prohibiting discrimination based on race, creed, color, sex, age, religion, national origin or disability in employment. KRS 45.560 KRS 45.640.
- b. The utilization of minority vendors and subcontractors is encouraged, whenever possible, on public works contracts. The bidder and contractor should make full efforts to locate minority business persons. KRS 45A.610.
- c. Unless exempted in accordance with KRS 45.590, the provisions of KRS 45.560 KRS 45.640 shall be binding upon the declared successful bidder and the resulting contract shall contain the provisions set forth in KRS 45.570(2).
- d. Unless a bidder is exempt under KRS 45.560 KRS 45.640, the apparent successful bidder shall submit to the purchasing agency in the manner described and on the form(s) required, the information required by KRS 45.600 within five (5) calendar days of being declared the apparent low bidder. The form(s) shall be reviewed by the FAC Office of Equal Employment Opportunity and Contract Compliance.

17. Performance and Payment Bonds:

- a. Pursuant to KRS 45A.190 and KRS 45A.195, a bidder shall deliver the required performance and payment bonds to the purchasing agency upon notification of intent to award, or, with the approval of the purchasing officer, within fourteen (14) calendar days after that date. Otherwise, the Commonwealth may determine that the proposed awardee has abandoned the Bid Response and the bid shall become null and void.
- b. Unless otherwise specified in the bidding documents, the bonds shall be written on the form bound in the bidding document in the number of copies to be specified by the purchasing officer.
- c. A bidder shall require the attorney-in-fact, who executes required bonds on behalf of the surety, to affix thereto a certified and current copy of his/her Power of Attorney. The date of the Power of Attorney shall not precede the date of the bonds. The bonds shall be executed with a licensed resident or non-resident agent, who represents insurance companies authorized to do business in Kentucky.

18. Award of Contract:

- a. The issuance of an award of a contract is contingent upon securing an acceptable bid that is within the amount of budgeted funds and determining that the award of contract is in the best interest of the Commonwealth.
- b. Unless otherwise provided in the bidding documents, the Agreement between the Commonwealth and the contractor shall be written on the standard form of agreement bound within the Solicitation. The Commonwealth shall not be required to enter into or sign further agreements, leases, company orders or other documents to complete the Agreement.
- c. The Commonwealth's acceptance of the bidder's offer in response to the Solicitation, indicated by the issuance of a contract award, shall create a binding agreement between the parties consisting of the documents listed below. In the event of a conflict between the provisions contained in the contract, the order of precedence shall be in the same listing order as below.
 - 1. Solicitation including any addenda;
 - Specifications;

- 3. Special Conditions;
- 4. General Conditions;
- 5. Technical provisions of the specifications;
- 6. Drawings/plans; and
- 7. Bid Response to the Solicitation.
- 19. Award of Construction and Construction-Related Contracts: Capital construction funded contracts require properly authorized Appropriation, Allotment, Revenue Budget, Project Management Master and Journal Voucher Transfer documents (SAS-5, SAS-14) for award of contract and allocation of construction funds. The issuing agency shall execute a construction contract using agency or general fund accounts on the basis of a duly signed agency Purchase Request.



FINANCE AND ADMINISTRATION CABINET DEPARTMENT FOR FACILITIES MANAGEMENT DVISION OF ENGINEERING AND CONTRACT ADMINISTRATION

GENERAL CONDITIONS of the Contract for Construction - General Contractor

These **General Conditions of the Contract for Construction – General Contractor** have been implemented by the Kentucky Division of Engineering and Contract Administration for the purpose of delineating the provisions of the Contract for Construction when the Commonwealth has entered into a Contact with a General Contractor to accomplish a Capital Construction Project. The Document as a whole outlines the primary obligations and basic expectations for each entity involved in the Project.

These General Conditions apply to each section of the specifications and to the Contract Documents as a whole and are binding upon the Contractor and all Subcontractors as each are subject to the provisions contained herein.

These General Conditions are intended to define and establish certain definitions, procedures, rules and provisions of the Contract governing the operation so that the Work may be continued and be completed in an orderly, expeditious and workmanlike manner.

These General Conditions, together with the specifications and Contract Documents, shall further establish the standards of material and workmanship for the Work.

Specific Project requirements may alter the provisions indicated herein where strict adherence to the provisions of this document are not warranted or applicable. The Special Conditions and Supplemental Conditions contained in the Contract Documents, if present, modify and take precedence over the provisions of these General Conditions for this specific Project.

These General Conditions are based on and are consistent with the specific Kentucky Revised Statues passed by the Kentucky Legislature and signed into effect by the Governor; specific Kentucky Administrative Regulations promulgated by State Agencies to enhance and clarify procedures that are authorized by a specific statute; specific Finance Cabinet Administrative Regulations; and the DECA Procedures Manual.

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Articles

'1. Definitions of Terms

Wherever used in these General Conditions or in other Contract Documents, the following terms have the meaning indicated which are applicable to both the singular and plural thereof:

- **'1.1 Addenda** Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirements or the Contract Documents. An Addendum supersedes related provisions of the Contract Documents which are clarified, corrected or changed by the addenda.
- **'1.2 Agency or Using Agency**, defined by KRS 45a.030, and is the state government entity which utilizes the Work being contracted. The Agency is a "client" of the Owner and advises the Owner of the needs, requirements and desires of the Agency related to the project. The Owner consults with the Agency on matters related to the Project. The Agency does not possess the legal authority of the Owner (see KRS 45a.045).
- **'1.3 Architect, Engineer or Consultant (A-E)** is the person or entity, either a registered Architect, Registered Engineer, or Consultant, who is identified as such in the Contract Documents and on the drawings or any replacement Registered Architect, Registered Engineer, or consultant identified by the Owner. The A-E is a separate contractor and not an agent of the Owner. The term includes any associates or consultants employed by the A-E to assist in providing the required professional services to the Owner.
- **'1.4 Certification of Payment** is the Owner's Progress Payment Forms, DOA-24 and DOA-25. All Payments made to the Contractor under this contract shall be on the appropriate Owner's Progress Payment Form.
- **'1.5 Change Order** means a written order to the Contractor executed by the Owner and the A-E after execution of the Contract, directing a change in the Work and may include a change in the Contract Price or the Contract Time, or any combination thereof. There shall be no authorized changes in the Work, which affect either Contract Price or Contract Time, without a fully executed Change Order, except as provided elsewhere herein.
- **'1.6 Contract** is the legal relationship, duties and obligations between the Owner and Contractor as evidenced by the Contract Documents for the Project.
- **11.7 Contract Time** is the number of calendar days between the Date of Commencement and the dates set for Substantial Completion and Final Completion of the Work, including any adjustments thereto, all as established in the Contract between Owner and Contractor
- **'1.8 Contract Documents** include the Invitation for Bids, the Instructions to Bidders, the Payment and Performance Bonds, the General Conditions, the Special or Supplemental Conditions, the drawings, specifications, solicitation addenda, the contractors response to the solicitation, any written clarification of the response, the award document containing the Agreement between Owner and Contractor, and modifications issued after execution of the Contract. Modifications include (1) Change Orders issued as provided in Article 14, and (2) Field Orders for minor changes in the work issued by the A-E as provided in Article 14. Documents not included or expressly contemplated in this Paragraph, 1.8, do not, and shall not, form any part of the Contract between the Owner and the Contractor.
- '1.9 Contract Sum means the sum stated in the Contract including any authorized adjustments thereto and is the total amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents.

- **'1.10 Contractor or General Contractor** means the person or entity with whom the Owner has executed the Contract for construction. The Contractor may also be referred to as General Contractor. The Contractor shall hold his subcontractors, suppliers and others under his employ or contract to the terms and conditions of the Contract Documents.
- **'1.11 Damages for untimely performance** means a calculated monetary amount to be paid to the Owner, based on real costs which the Commonwealth incurs, due to the Contractor's failure to complete the Work within the allowable time identified in the Contract Documents. This term may also be referred to as "Liquidated Damages" where the actual cost of damages for untimely performance cannot be readily calculated and a definite sum is predetermined to be paid to the Owner. The amount of Liquidated Damages shall be defined in the Special Conditions of this Project.
- **'1.12 Date of Commencement** is the date specified in the Contract as the date upon which the Contractor is authorized to begin work. The Contract Time as set forth in paragraph 1.7 is determined using this Date of Commencement as the starting date.
- **'1.13 DECA Project Manager** means the person(s) delegated authority to act on behalf of the Owner. Such person(s) is employed by the Owner, DECA's Project Manager(s) will be designated at the Pre-Construction Meeting. DECA reserves the right to change its designated Project Manager(s) at any stage of the Work, for the sole purpose or benefit of the Commonwealth.
- **'1.14 Delay** means an event that causes an increase in the duration of the Project, or that changes the sequence of the Work or individual Work activities, thereby preventing completion of the Project within the time period specified in the Contract Documents. An event that does not cause an increase in the duration of the Project or prevents the completion of the Project within the time period specified in the Contract Documents, such as an event that is not on the critical path of the project schedule, is not a delay under this Contract.
- **'1.15 Direct Expenses** is defined as "All items of expenses directly incurred by or attributable to a specific project, assignment or task" and "Direct costs consist of direct materials, direct labor, subcontract costs, and other miscellaneous direct costs such as bonding and equipment rentals, that are directly related to and can be specifically attributed to an individual contract."
- **'1.16 Drawings** are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams. Where it is obvious that a drawing illustrates only a part of the given work or of a number of items, the remainder shall be deemed repetitious and so construed.
- **'1.17 Document Collaboration** is the Owner's web-based document collaboration system that shall be used by all project participants for the submission, transmittal, transfer, review, approval, processing of all documents related to this project. Where the General Conditions, the technical specifications, or the Contract for Construction indicates that a submission of documents is required, this submission shall be through the Owner's Document Collaboration System.
- **'1.18 Extra Work** as used in Article 14 is defined as Work not part of the existing Contract Documents which is being added to the Contract by a fully executed Change Order.
- **'1.19 A Field Order** is a written order issued by the A-E which clarifies or interprets the Contract Documents, or orders minor changes in the Work which does not require a change under Article 14. Field Orders are issued to the Contractor through the Owner's Document Collaboration System. Field Orders are also called A-E's Supplemental Instructions (ASIs).
- **'1.20 Final Completion** is defined as the Work being acceptable under the Contract Documents and the Contract fully performed in accordance with the terms and conditions of the Contract Documents and the entire payment balance due the Contractor is due and payable.

- '1.20.1 Final Completion Date shall have the meaning as described to it in Article '19.5.
- **'1.21 Notice of Intent to Award** is a written letter issued to the apparent successful contractor after acceptance of bid price, unit prices, subcontractors and equipment and materials to inform them of such acceptance and request the required additional documentation to initiate the Contract. **This is NOT an authorization to proceed.**
- **'1.22 Owner** means the Commonwealth of Kentucky, acting through the Finance and Administration Cabinet and its Administrative Agent, the Department for Facilities and Support Services, Division of Engineering and Contract Administration. The Owner is represented solely by the Division of Engineering and Contract Administration. The Owner is represented by the DECA Project Manager for the specific Project.
- **'1.23** The **Project** is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by other Contractors, working under separate Contract with the Owner.
- **'1.24 Resident Observer** means an individual who has a direct contract with the A-E to observe and report on activities at the work site. A Resident Observer employed by the A-E is not authorized to serve as the Owners Representative, unless so designated by the Owner in writing.
- **'1.25 Retainage** means money earned by a contractor for work accepted by the Owner, but withheld to ensure proper performance by the contractor. Retainage is further defined in Article '18.
- **'1.26 Shop Drawings** means drawings, completion diagrams, schedules, and other data specially prepared for the Work by the Contractor or any Subcontractor, lower tier subcontractors, manufacturer, supplier, or distributor to illustrate some portion of the Work. Shop Drawings and other submittals from the Contractor to the A-E shall be transmitted through the Owner's Document Collaboration System. Unless other requirements are indicated in the Special Conditions for this project or unless otherwise permitted by the A-E in writing, all shop drawings required by the Contract Documents shall to be submitted to the A-E for review and acceptance within the time indicated below:
 - **'1.26.1** For **Projects of less than 180 calendar day duration:** thirty (30) calendar days of the Date of Commencement.
 - '1.26.2 For Projects of more than 181 calendar days and less than 360 calendar days duration: less than sixty (60) calendar days of the Date of Commencement.
 - **'1.26.3 For Projects of more than 361 calendar days duration**: less than ninety (90) calendar days of the Date of Commencement.
 - **'1.26.4 In circumstances where a specific shop drawing required by the Contract Documents cannot reasonably be submitted** to the A-E for review and acceptance, the Contractor shall notify the A-E in writing within the time periods indicated above for submission, and if the A-E finds it reasonable to waive this submission time period requirement, the A-E may do so in writing.
 - **'1.26.5** In circumstances where a specific shop drawing required by the Contract Documents cannot be reasonably reviewed by the A-E within the time prescribed elsewhere in the Contract Documents, the A-E shall notify the Contractor in writing prior to the date required for the review of the reasons for the time needed for reviewing the Shop Drawing.

- **'1.27 Specifications** are the descriptive and written portions of the Contract Documents, wherever located and whenever issued, that describe the quality and performance of building materials and systems, using code citations and published standards. The drawings and specifications are complementary, together providing the information required for a complete facility. However, the specifications overrule the drawings where there is a conflict or contradiction. However, the Contractor shall inquire of the A-E for a determination of the resolution of the conflict or contradiction.
- **'1.28 Subcontractor** means the person or entity having a direct contract with the Contractor for the performance of a part of the Work. The Owner has no direct contractual relationship with the subcontractor.
- **'1.29 Substantial Completion** is the point at which, as certified in writing by the A-E and accepted by the Owner that the Project is: 1) at a level of completion in strict compliance with the Contract (see article '19.4 for a complete listing of requirements for compliance); 2) all necessary approvals by public authorities has been given; and, 3) that the Owner or the Agency can enjoy beneficial use or occupancy and can use, operate and maintain (the Owner has received all required warranties and documentation) it in all respects, for its intended purpose. Partial use or occupancy of the Project shall not result in the Project being deemed substantially complete and such partial use or occupancy shall not be evidence of Substantial Completion.
 - '1.29.1 Substantial Completion Date shall have the meaning as described to it in Article 19.
- **1.30 Warranty, General.** The Contractor shall warrant all equipment, materials, products, and workmanship provided by the Contractor under these Contract Documents for a period of twelve (12) months after the Date of Final Completion. This period of time is called the One-Year Warranty Period and is further defined in Article 9.2.
- **'1.31 The Work** includes the construction and services required by the Contract Documents, whether completed or partially completed, and includes all labor, supervision, materials, equipment, services, and things provided or to be provided by the Contractor to fulfill the Contractor's obligations.

'2. Intent and Interpretation

The A-E shall be the authority of the Contract Documents as to their intent or interpretation, except as defined below and/or as provided in paragraph 3.4.

- **'2.1** Anything that may be required, implied or inferred by the documents which make up the Contract, or any one or more of them, shall be provided by the Contractor for the Contract Sum;
- **'2.2** Nothing contained in the Contract Documents shall create, nor be interpreted to create, privity or any other relationship whatsoever between the Owner and any person except the Contractor;
- **'2.3** When a word, term, or phrase is used in the Contract Documents, it shall be interpreted or construed first, as defined herein; second, if not defined, according to its generally accepted meaning in the construction industry; and third, if there is no generally accepted meaning in the construction industry, according to its common and customary usage;
- **'2.4** The words "include", "includes", or "including", shall be deemed to be followed by the phrase, "without limitation".
- '2.5 The specification herein of any act, failure, refusal, omission, event, occurrence or condition as constituting a material breach of the resulting Contract shall not imply that any

other, non-specified act, failure, refusal, omission, event, occurrence or condition shall be deemed not to constitute a material breach of the resulting Contract:

- **'2.6** In the event of any conflict, discrepancy, or inconsistency, the following shall control:
 - **'2.6.1** As between figures given on plans and scaled measurements, the figures shall govern; When two or more figures given on the plans are in conflict, the Contractor shall inform the A-E of such conflict immediately and the A-E shall clarify the correct figure to be used. The Contractor shall not proceed with any work related to the figures in conflict until the A-E has provided this clarification.
 - **'2.6.2** As between large scale plans and small scale plans, the large scale plans shall govern;
 - **'2.6.3** As between plans and specifications, the requirements of the specifications shall govern; When there is a conflict between the plans and specifications, the Contractor shall inform the A-E of such conflict immediately and the A-E shall clarify the correct interpretation to be used. The Contractor shall not proceed with any work related to the conflict until the A-E has provided this clarification.
 - **'2.6.4** When any conflict, discrepancy, or inconsistency exists as described in Article '2.6, and when there is a necessary determination by the A-E, with agreement by the Owner, that the provisions indicated above do not result in the proper interpretation and resolution of the conflict, the A-E may provide written directive as to how the conflict is to be resolved.
 - **'2.6.4.1** When such written directive, as indicated in '2.6.4 results in a cost difference to properly resolve the conflict, discrepancy, or inconsistency, a cost adjustment may be determined by the A-E to be appropriate.
 - **'2.6.4.2** The Contractor shall notify the A-E/ Owner of his proposed necessity of a cost difference result within fourteen (14) calendar days of the receipt of the directive to resolve the conflict. However, should the Contractor proceed with the work related to the conflict resolution without written notice of the proposed cost difference to the A-E within the prescribed time, no cost adjustment will be granted.
- **'2.7 Meaning of Execution.** Execution of the Contract Documents by the Contractor is a representation that the Contractor has thoroughly examined the site of the Work, become familiar with the local conditions under which the Work is to be performed, and correlated personal observations with the requirements of the Contract Documents.
 - **'2.7.1** Execution of the Contract Documents is a further representation that Contractor has received, reviewed and carefully examined all of the Contract Documents, and has found them in all respects to be complete, accurate, adequate, consistent, coordinated and sufficient for construction, the Contractor is fully qualified to act as the contractor for the Project and has, and shall maintain, any and all licenses, permits or other authorizations necessary to act as the contractor for, and to construct the Project.
- **'2.8 Prior Agreements.** The Contract Documents supersede any and all prior discussions, communications, representations, understandings, negotiations or agreements between the Owner and the Contractor and the Agency and the Contractor.
- **'2.9 Contractor's Performance.** The Contractor shall perform all of the Work required, implied or reasonably inferable from the Contract including, but not limited to, the following:
 - '2.9.1 Construction of the Project;

- '2.9.2 The furnishing of any required surety bonds and insurance;
- **'2.9.3** The provision or furnishing, and prompt payment therefor, of labor, supervision, services, materials, supplies, equipment, fixtures, appliances, facilities, tools, transportation, storage, power, fuel, heat, light, cooling, or other utilities, required for construction and all necessary building permits and other permits required for the construction of the Project;
- **'2.9.4** The creation and submission to the A-E of detailed and comprehensive record drawings and specifications, depicting all as-built construction. Said as-built drawings shall be submitted to the Owner by the A-E upon Final Completion of the Project and receipt of same by the Owner shall be a condition precedent to final payment to the Contractor and to the A-E.
- **'2.10 Time.** All limitations of time set forth in the Contract Documents are material and are of the essence of the Contract. The Contractor shall execute the work in such a manner as consistent with the limitations of time set forth. The Contractor shall make reasonable progress on the completion of the Work on a continual and consistent basis. Any failure of the Contractor to execute the Work in a timely manner consistent with the limitations of time set forth in the Contract Documents may be deemed at a Material Breach of Contract.
- **'2.11 Intent of Contract Documents.** The intent of the Contract Documents is to include all items necessary for the proper completion of the Work by the Contractor. Labor or materials which are evidently necessary to produce the desired results, even though not specifically mentioned in the Contract Documents, shall be included in the Work. The A-E is the interpreter of the Contract Documents and where any clarification regarding interpretation of the Documents is required the A-E shall be notified in writing pursuant to paragraph 2.13 below.
- **'2.12 Contract Documents Complementary, etc.** The Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In case of conflicts between the various Contract Documents, the order of precedence shall be as follows: (1) Addenda, (2) Special Conditions, (3) General Conditions, (4) Division 1 General Requirements of the Specifications; (5) Technical provisions of the Specifications; (6) Drawings.
- **'2.13 Questions to A-E.** In the event a question arises regarding the meaning or intent of the drawings and specifications, the Contractor shall report it at once to the A-E by the submission of a Request for Information through the Owner's Document Collaboration System. The A-E shall furnish, with reasonable promptness, as defined by the Contract between the Owner and the A-E, additional instructions, by means of drawings or otherwise, necessary for the proper execution of the work, consistent with the requirements of Article 3.
- **'2.14** Paragraph, titles, headings, and drawing numbers are for convenience only and form no operative part of the Contract. The General Contractor, and by the "flow down" provisions of these General Conditions, every subcontractor, shall provide all Work defined, identified, enumerated, specified or otherwise indicated to be provided by the Contract Documents.

'3. The Architect, Engineer, Consultant (A-E)

Unless otherwise directed by the Owner in writing, the A-E shall perform those duties and discharge those responsibilities allocated to the A-E in the Contract Documents. The duties, obligations and responsibilities of the A-E shall include, but are not limited to, the following:

'3.1 Owner's Representative. The A-E will be the Owner's Agent during construction, through issuance of final payment, and during the contractor's One Year Warranty period. The A-E will advise and consult with the Owner. In the event the Owner should find it necessary or

convenient to replace the A-E, the Owner shall retain a replacement A-E and the role of the replacement A-E shall be the same as the role of the A-E.

- **'3.2 Communication through A-E.** Except as otherwise provided in the Contract Documents, the Owner's instructions to the Contractor shall be through the A-E and the Contractor's communications with the Owner shall be through the A-E. Should the contractor act on communications from any other entity, other than through the A-E, he is acting at his own risk and may be required to reverse the actions taken as his own expense.
 - **'3.2.1** All documents related to this project shall be submitted, transmitted, transferred, reviewed, approved or rejected, and/or otherwise processed using the Owner's Document Collaboration System which is the Owner's web-based document collaboration system that shall be used by all project participants. No submission, transmittal, transfer, review, approval or processing shall be deemed Official without the use of this system.
 - **'3.2.1.1 All documents transmitted for purposes of administration of the Contract** are to be in electronic (PDF) format and transmitted via the Commonwealth's Document Collaboration System that receives, logs and store documents, processes documents through workflows and notifies addressees via email.
 - **3.2.1.2** The A-E/ Engineer and the Contractor are required to become familiar with this system, to use this for all official transmittal of information pertaining to this project, and to respond to the requirements of this system within a reasonable time as defined elsewhere herein and/or by the terms of their Contract with the Owner.
 - **3.2.1.2.1 Training:** The Owner has an agreement with the service provider of the Document Collaboration System to provide training, support and assistance to users of the system via a web-based training session which can be arranged upon request. Further training as may be required by a specific user of the system is the responsibility of the user of the system.
- **'3.3 Review of Work.** The A-E shall approve, or respond otherwise, in a timely manner, as defined by the Contract between the Owner and the A-E, as necessary concerning shop drawings or other submittals received from the Contractor. Should the A-E have reasonable cause to be unable to approve, or respond otherwise to submissions from the Contractor, the A-E shall provide written explanation of the reasonable cause within the timely manner, as defined by the Contract between the Owner and the A-E.
 - **'3.3.1 The A-E shall be authorized to refuse to accept work** which is defective or otherwise fails to comply with the requirements of the Contract. The A-E shall refuse the work in writing when he deems it necessary to refuse the work. If the A-E deems it appropriate, the A-E shall be authorized to call for extra inspection or testing of the work for compliance with requirements of the Contract.
 - **'3.3.1.1 The costs of the extra inspection or testing** shall be paid by the Contractor, unless the results of the extra inspection or testing find that the work was originally in conformance with the Contract requirements and that the extra inspection or testing was not necessary. A reduction in the Contract Sum shall be provided by Change Order to reimburse the Owner for the costs of the extra inspection or testing.
 - **'3.3.1.2 In cases where the Contractor covers up work** that is required by the Contract Documents to be inspected or tested prior to the inspection or testing, the cost of uncovering the work and performing the inspection or testing shall be at the

Contractor's expense even if the work is found to have been originally in conformance with the Contract Documents. A reduction in the Contract Sum shall be provided by Change Order to reimburse the Owner for the costs of the extra inspection or testing.

- **'3.3.2 The A-E shall review the Contractor's Payment Requests** and shall approve in writing those amounts which, in the opinion of the A-E, are properly owing to the Contractor as provided in the Contract. The A-E shall perform this review, approval and submission of his recommendation to the Owner, within ten (10) business days of receipt of the Payment Request from the General Contractor.
- **'3.3.3** The A-E shall perform those inspections required by the Owner.
- **3.4 Interpretation of Contract Documents.** The A-E shall be the interpreter of the requirements of the Contract Documents and the judge of the performance thereunder by the Contractor, subject to the provisions of Article 26.
 - **'3.4.1 Claims, disputes, and other matters in question** that arise relating to the execution or progress of the Work shall be referred initially to the A-E for decision, which he will render in writing within a reasonable time, as defined by the Contract between the Owner and the A-E.
 - **'3.4.2 Should the Contractor find disagreement with the** A-E as to the proper interpretation of the Contract Documents or other decision of the A-E, he must refer the A-E's decision to the Director of the Division of Engineering in writing within seven (7) days. The Director of the Division of Engineering will then discuss and negotiate the A-E's decision with the A-E to seek reasonable resolution of the matter. Following these discussions and negotiations, the A-E's initial decision or revised decision shall be binding, unless the Contractor appeals the A-E's initial or revised decision to the Secretary of the Finance and Administration Cabinet in accordance with the provisions of Article 26.
 - **'3.4.3 Should the Director of the Division of Engineering find disagreement with the** A-E as to the proper interpretation of the Contract Documents or any other decision of the A-E, the Director of the Division of Engineering may appeal the A-E's initial or revised decision to the Secretary of the Finance and Administration Cabinet in accordance with the provisions of Article 26.
 - **'3.4.4 The A-E shall have authority to reject Work** which does not conform to the Contract Documents. In the event of rejection, the A-E may recommend in writing withholding payment to the Contractor for the rejected Work, and such recommendation shall give the Owner the authority to withhold payment for such Work.
- **'3.5 Review of Shop Drawings, etc.** The A-E shall review and approve, or take other appropriate action upon Contractor's submittals (such as Shop Drawings, product data, and samples) for conformance with the design concept and the information given in the Contract Documents. Such action shall be taken with reasonable promptness, as defined by the Contract between the Owner and the A-E, so as to cause no delay. The A-E may determine concurrently with the Contractor the timing and scheduling of the A-E's Review, with the understanding that some submittals are more critical to the Critical Path of the Completion of the project than others.
 - **'3.5.1 The A-E's approval** of a specific item shall not indicate approval of an assembly of which the item is a component. The A-E's approval of Shop Drawings or samples shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the A-E's attention to such deviation at the time of submission and the A-E has given written approval to the specific deviation, nor shall any approval by the A-E relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.

- **'3.5.2 If, for any reason, any item specified and approved by the A-E as a shop drawing submittal, will not be available when needed** in the course of the work, and Contractor can show he has made a reasonable, persistent effort to obtain item in question, the Contractor is to notify the A-E in writing, immediately, and the A-E will either determine the source of the supply or arrange with the Owner for appropriate substitution, within the terms of the Contract. Otherwise, the Contractor will not be excused for delays in securing materials or products specified, and will be held accountable if completion of the project is thereby delayed.
- **'3.6 Preparation of Change Orders.** The A-E, in consultation with the Owner, shall prepare Change Orders. The A-E shall also have authority to order minor changes in the Work as provided in Article 14.2.
- **'3.7 Final Inspections, Certification.** The A-E, in consultation with the Owner, shall conduct inspections to determine the dates of Substantial Completion and Final Completion. The A-E shall also receive and forward to the Owner, for the Owner's review, written warranties and related documents required by the Contract and assembled by the Contractor.
- **'3.8 The A-E shall review the Contractor's Payment Requests** and shall approve in writing those amounts which, in the opinion of the A-E, are properly owing to the Contractor as provided in the Contract. The A-E will perform this review, approval and submission of his recommendation to the Owner, within ten (10) business days of receipt of the Payment Request from the Contractor.
 - 3.8.1 When there is reasonable justification that causes the A-E to be unable to perform this review, approval and submission of his recommendation to the Owner within the time prescribed in paragraph 3.8 above, the A-E will notify the Contractor in writing as to the justification and as to the time that will be required for this review, approval and submission of his recommendation to the Owner.
 - **'3.8.2 The Contractor may submit no more than one (1) payment request** each thirty (30) calendar day period, except where specifically agreed by the Owner that additional payment requests may be submitted within the thirty (30) calendar day period for reasons consistent with the Contractor's performance of the Contract.
- '3.9 The A-E, in consultation with the Owner, shall be authorized to require the Contractor to make changes or deviations in the work which do not involve a change in the Contract Sum or in the Contract Time for the Contractor's performance consistent with the intent of the Contract. The A-E shall make such changes or deviations in the work by written Field Order.
- **'3.10** The duties, obligations and responsibilities of the Contractor under the Contract shall in no manner whatsoever be changed, altered, discharged, released, or satisfied by any duty, obligation or responsibility of the A-E. The Contractor is not a third-party beneficiary of any Contract by and between the Owner and the A-E. It is expressly acknowledged and agreed that the duties of Contractor to the Owner are independent of, and are not diminished by, any duties of the A-E to the Owner.
- **'3.11** The duties, obligations and responsibilities of both the A-E and the Contractor, under their respective Contracts, shall in no manner whatsoever be changed, altered, discharged, released, or satisfied by any duty, obligation or responsibility of the Resident Observer. It is expressly acknowledged and agreed that the duties of Contractor and/or A-E to the Owner are independent of, and are not diminished by, any duties of the Resident Observer to the A-E/Owner. A copy of the Resident Observers Duties, Responsibilities and Limitations

are enumerated in the DECA Procedures Manual, are to be discussed at the Pre-Construction Meeting and are by reference made a part of these General Conditions.

'4. Construction Schedule

The Contractor, within fifteen (15) days of the Date of Commencement shall prepare and submit for the Owner and A-E's approval a construction schedule for completing the Work. This submission shall be transmitted through the Owner's Document Collaboration System. The schedule shall indicate the starting and completion dates of the various stages of the Work, shall not exceed time limits established by the Contract Documents for the various stages of Work, shall be updated monthly and furnished to the Owner and A-E, shall be related to the Work of any other contractors on the Project to the extent required by the circumstances, and shall provide for expeditious and practicable execution of the Work. Progress *Payments to the Contractor are contingent upon receipt of the updated monthly project schedule and schedule of submittals*.

- **'4.1 Time Frame of Schedule:** Extend schedule form date established **for commencement of the Work** (the Notice of Award or Notice to Proceed) to **Substantial Completion**, to **Final Completion**, and indicating all critical milestones along the time of the schedule.
 - **'4.1.1 Work by Owner**: Include a separate activity for each portion of the Work to be performed by the Owner or by others working under separate contract with the Owner.
 - **'4'1.2 Products Ordered in Advance:** Include a separate activity for each product preordered by the Owner. Include the delivery date indicated in the Special Conditions or as relayed to the Contractor from the Owner.
 - **'4.1.3 Work Restrictions and "blackout dates":** Show the effect of specified work restrictions and "blackout dates" as defined in the Special Conditions.
 - **'4.1.4 Commissioning:** Show separate activities for each building system to receive commissioning by others working under separate contract with the Owner, allowing sufficient time for functional startup, commissioning, correction of commissioning issues and final commissioning. Note: Commissioning must be accomplished in its entirety by the Date of Substantial Completion.
 - **'4.1.5 Testing and Balancing:** Show separate activity for testing and balancing by others working under separate contract with the Owner. Note: Testing and Balancing must be accomplished in its entirety by the Date of Substantial Completion.
- **'4.2 The original schedule** shall be accompanied by a proposed schedule of values as described in Article 18.1. The original Project Schedule, Schedule of Submittals and the Schedule of Values are to be submitted to the A-E, reviewed and accepted by the A-E and the Owner, prior to submittal of the first Progress Payment. No payment will be made to the Contractor without an approved Schedule of Values and a Project Schedule.
 - **'4.2.1 The original schedule** shall show the project being completed on the established Date of Substantial Completion. To do this, the Contractor shall include in the flow of work any existing "float" which may be identified during the layout of the project schedule.
 - **'4.2.2 The Contractor acknowledges that all float** (including Total Float, Free Float, and Sequestered Float) is a shared commodity available to the Project and is not for the exclusive benefit of any party; float is an expiring resource available to accommodate changes in the Work, however originated, or to mitigate the effect of events that may delay performance or completion of all or part of the Work.

- **'4.3 The Contractor shall promptly notify the A-E and Owner** if the Contractor is materially ahead of, or behind the updated construction schedule. Failure to so notify the A-E and Owner shall relieve the Owner from liability for damages caused by delay or impact. Strict compliance with the requirements of this article shall be a condition precedent to payment to the Contractor, and failure by the Contractor to strictly comply with said requirements shall constitute a material breach of the Contract.
 - **'4.3.1 On projects where a CPM schedule is required, the Contractor shall report on the status of any "float"**, including the addition of "float", the use of "float", and the anticipation of the use of "float" at each project Progress Meeting.
- **'4.4 For projects with a Contract Sum of \$1,000,000 or greater** the schedule shall be in critical path method (CPM) format. The schedules shall include all activities necessary for performance of the work showing logic (sequences, dependencies, etc.) duration of each activity with the critical path highlighted. The schedules shall include, but not be limited to, submittal processing and review time required by the A-E, fabrication and delivery of materials, construction, testing cleanup, work and/or materials to be provided by the Owner, dates and durations for major utility outages requiring coordination with the Owner and the Owner's operations, and significant milestones related to the completion of the Project.
 - **'4.4.1 For projects where the CPM format is required for schedules,** any subsequent adjustment, modification or change in the schedule shall include an indication of the original Critical Path and the adjustment, modification, or change shall clearly delineate the adjustment, modification or change in the schedule and shall be accompanied by a written statement of the cause and reason for the adjustment, modification or change.
 - **'4.4.2 For projects where the CPM format is required for schedules and subsequent adjustment, modification or change in the schedule** does not include the information required by paragraph 4.3.1 above, the revised schedule shall be rejected and payment of the Contractor's General Conditions costs suspended until this provision is complied with satisfactorily.
- **'4.5 Work Hours on site shall be coordinated with the A-E, Owner and Using Agency and shall be initially defined and scheduled at the Pre-Construction Conference,** adjusted by notification to the A-E, Owner and Using Agency during each monthly Progress Meeting, and shall comply with the following criteria:
 - **'4.5.1 Generally, work hours on site shall be** from 7am to 4pm, weekdays, unless otherwise defined in the Special Conditions. However, unless restricted or modified by the Special Conditions, the Contractor may propose a different work hour schedule up to 24/7/365 with acceptance by the Owner.
 - **'4.5.2 The Contractor shall have job site supervision on site** during any work hours scheduled and/or any extended work hours accepted by the Owner.

'5. Shop Drawings; Submittals

'5.1 Schedule for Submittals. Prior to submission of the first application for payment and in sufficient time to allow the A-E reasonable time for review, the Contractor shall submit to the A-E a schedule of submittals which shall be coordinated with the construction schedule. This submission shall be transmitted through the Owner's Document Collaboration System. The Contractor shall keep the schedule of submittals current and present an updated schedule of submittals at each project progress meeting. This schedule of submittals shall contain anticipated and actual dates of the submittal of shop drawings and shall be consistent with the requirements for scheduling submittals defined in Article 1.26 of these General Conditions.

- **'5.2 Submittals of Shop Drawings, Samples, etc.** The Contractor shall review, approve, and submit Shop Drawings, samples, and product data in accordance with the approved schedule as herein detailed.
 - **'5.2.1 The Contractor's stamp of approval** on any Shop Drawing or sample shall constitute a representation to Owner and A-E that the Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, or he assumes full responsibility for doing so, and that he has reviewed or coordinated each Shop Drawing or sample with the requirements of the Work and the Contract Documents.
 - **'5.2.2 The A-E shall review and approve, with reasonable promptness** as defined by the Contract between the Owner and A-E, the Shop Drawings, or return for corrections as required. The review and approval shall be for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents. The approval of a separate item will not indicate approval of the assembly in which the item functions.
 - **'5.2.3 The Contractor shall make any corrections required** by the A-E for compliance to the Contract and shall return the required number of corrected copies of Shop Drawings and resubmit new samples until approved. The Contractor shall direct specific attention, in writing, or on resubmitted Shop Drawings, to revisions other than the corrections called for by the A-E on previous submissions.
 - **'5.2.4 Where a Shop Drawing or sample submission is required** by the specifications, no related work shall be commenced until the submission has been approved by the A-E. A copy of each approved Shop Drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the A-E, Owner and Resident Observer.
 - **'5.2.5 The A-E's approval of Shop Drawings or samples** shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the A-E's attention to such deviation at the time of submission and the A-E has given written approval to the specific deviation, nor shall any approval by the A-E relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.
 - **'5.2.5.1 Conflicting Requirements:** If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the A-E for decision before proceeding with the work.
 - **'5.2.6 The Contractor shall maintain a submittal log** which shall include, at a minimum, the date of each submittal, the date of any resubmittal, the date of any approval or rejection, and the reason for any approval or rejection. The Contractor shall provide copies of this submittal log with the current status of submittals clearly indicated therein to the A-E and the Owner at each progress meeting until such time as all submittals are complete and accepted.
- **'5.3 Photographic Documentation:** Provide Pre-Construction Photographs, Construction Progress Photographs and Substantial Completion construction photographs. Submit photographs in the Owner's Document Collaboration System with a key plan or description of the location of the photograph taken.

- **'5.3.1 Pre-Construction Photographs:** Take a minimum of 20 photographs to show existing conditions of the project site and adjacent property prior to the start of construction activities. Take additional photographs as necessary to adequately document the existing physical conditions of all improvements to the project site or adjacent property that might be affected by the activities of construction.
- **'5.3.2 Construction Progress Photographs:** Take a minimum of 10 photographs DAILY to document the progress of construction. Take additional photographs as necessary to adequately document the progress of construction indicating all key elements of the construction and any significant progress.
- **'5.3.3 Substantial Construction Photographs:** Take a minimum of 20 photographs to show conditions of the project site and adjacent property at the time of substantial completion of the work at the conclusion of construction activities. Take additional photographs as necessary to adequately document the current physical conditions of all improvements to the project site or adjacent property that might have been affected by the activities of construction.

'6. Documents and Samples at the Site

Unless otherwise provided in the Contract Documents, the General Contractor shall print and copy any drawings and specifications as are reasonably necessary for the execution of the Work. Each Subcontractor shall have the ability to download the entire set of drawings and specifications at its option, however, every Subcontractor shall be responsible for the scope of their work indicated in any location throughout the drawings and specifications. There is NO GUARANTEE of the division of the scope of work to specific specifications sections or specific drawings.

- **'6.1 The Contractor shall maintain at the site** one record copy of the drawings, specifications, addenda, Change Orders and other modifications, in good order and marked currently to record changes and selections made during construction. Unless otherwise directed, the Contractor shall also keep approved Shop Drawings, product data, samples and similar required submittals on hand. These shall be available to the A-E, Owner, and Resident Observer as requested.
 - **'6.1.1 When the Contractor fails to maintain the record copies indicated in paragraph 6.1 above**, payment of the Contractor's General Conditions costs may be suspended until this provision is complied with satisfactorily.
- **'6.2 Upon completion of the Work**, the record documents described above shall be delivered to the A-E for submittal to the Owner along with the as-built drawings.

'7. Contract Documents Property of Owner

The Contract Documents, and each of them, as well as any other documents furnished by the Owner, shall remain the property of the Owner. The Contractor shall have the right to keep one (1) copy of the Contract Documents upon completion of the Project; provided, however, that in no event shall the Contractor use, or permit to be used, any portion or all of such Contract Documents on other projects without the Owner's prior written authorization.

'8. Supervision and Construction Procedures

'8.1 Supervision of the Work. The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention so as to ensure expeditious, workmanlike performance in accordance with the requirements of the Contract Documents. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences

and procedures. He shall be responsible for the acts and omissions of persons directly employed by him, as he is for Subcontractors and others under Article 17. He shall be responsible for coordinating all portions of the Work under the Contract unless the Contract Documents give other specific instructions concerning these matters.

- **'8.2 Obligation to Follow Contract Requirements.** The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents by the activities or duties of the A-E in the A-E's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.
- **'8.3** The Contractor shall not perform Work without adequate plans and specifications, or, as appropriate, approved Shop Drawings, or other submittals. If the Contractor performs Work knowing or believing it involves an error, inconsistency or omission without first providing written notice to the A-E and Owner, the Contractor shall be responsible for such Work and pay the cost of correcting same.
- **'8.4 All Work shall strictly conform** to the requirements of the Contract Documents. The Contractor shall not commence or continue any portion of the Work where there is not a complete understanding of the requirements of the Contract Documents. When the Contractor believes that he does not have a complete understanding of the requirements of the Contract Documents, he shall immediately notify the A-E of this fact and shall issue a Request for Information to obtain this complete understanding of the requirements.
- **'8.4.1 All branches of work shown on the plans or specified**, whether specifically mentioned or not, shall be executed in strict compliance with all local, state or federal regulations and codes, where the same have jurisdiction. Where the Contractor may be in doubt as the application of a state regulation or code on a specific branch of work, the Contractor shall ask for an interpretation from the A-E prior to proceeding with the work.
- **'8.5 The Work shall be continually supervised**, the Contractor bearing full responsibility for any and all acts or omissions of those engaged in the Work on behalf of the Contractor
- **'8.5.1 The Contractor shall prepare Daily Construction Reports** and submit these reports through the Owner's Document Collaboration System a minimum of weekly. Failure to submit these Daily Construction Reports in a timely manner shall be reason for withholding of General Conditions amounts from the Contractor's payment requests until such submittal is completed.
- **8.5.2** The Contractor's Daily Construction Report shall contain as a minimum the following information in enough detail as to provide an accounting of the construction site conditions, activities and issues:
 - Contractor's Name
 - o Job Superintendent's Name
 - Date of Report
 - Weather Conditions precipitation, temperature, etc.
 - Manpower by trade including number of workmen.
 - Brief description of work performed that day.
 - o Conditions which delay progress of the work.
 - o Issues that arose needing resolution.
 - Resolution of prior issues that were implemented.
 - o Project Photographs, where appropriate.
- **'8.6 The Contractor shall at all times enforce strict discipline and good order** among his employees and Subcontractors and shall not employ on the Work any person not skilled in the Work assigned to him. Strict discipline shall include a prohibition of the use of drugs, alcohol or

any other controlled substance; prohibition of firearms or other weapons; prohibition of unnecessary contact with building occupants; and other objectives of good discipline.

- **'8.7** The Contractor shall employ and maintain at the Project site only competent supervisory personnel. Failure to provide proper job site supervision AT ALL TIMES THAT WORK IS IN PROGRESS shall be reason for a change order deduction of a portion of the General Conditions amounts from the Contractor's payment requests for the period of time that job site supervision is not provided.
- **'8.8 The Contractor shall have a continuing duty** to read, examine, review, compare and contrast each of the Contract Documents, Shop Drawings, and other submittals and shall give written notice to the Owner and the A-E of any potential conflict, ambiguity, error or omission which the Contractor may find with respect to these documents and their adequacy and sufficiency for construction as required by the Contract before proceeding with the affected Work. The express or implied approval by the Owner or the A-E of any Shop Drawings or other submittals shall not relieve the Contractor of the continuing duties imposed hereby, nor shall any such approval be evidence of the Contractor's compliance with the resulting Contract.
 - **'8.8.1** The **Owner has relied upon the A-E to prepare** documents for the Project, including the plans and specifications for the Project, which are accurate, adequate, consistent, coordinated and sufficient for construction, and in issuing the Contract to the Contractor, the Owner's established legal duties to the Contractor notwithstanding, the Owner has relied upon the A-E's professional expertise in fulfilling its legal duty to the Owner in addition to the Contractor's full and good faith compliance with its duties set forth above.
- **'8.9 Superintendent.** The Contractor shall employ a qualified, competent full-time superintendent and any necessary assistants. This superintendent shall be present on site at all times that Work of this contract is underway except with prior written consent of the A-E. It shall be the responsibility of the superintendent to coordinate the work of all the Subcontractors.
 - **'8.9.1 The Owner reserves the right to accept the Superintendent** selected by the Contractor. This full-time Project Superintendent shall be qualified and experienced to supervise the work of this Contract. The Contractor shall notify the A-E and Owner in writing for acceptance prior to any change in supervisory personnel. This change shall be for reasons outlined below.
 - **'8.9.1.1** The Contactor shall immediately replace a Superintendent upon written notice from the Owner that the current Superintendent is unsatisfactory. The Owner has the right to require replacement of a Superintendent at any time that the Owner loses confidence in the Superintendent: to adequately perform the duties required of the Contract Documents: to complete the Work in strict adherence to the Contract Documents; to maintain the project schedule; or to be present at the project site at all times Work is in progress, except as authorized by the A-E. The Owner also has the right to require the replacement of the Superintendent for inappropriate or unprofessional conduct either on the project site or directed toward the A-E/ Engineer, the Owner's Representatives (DECA personnel), the Using Agency Representatives, or the general public.
 - **'8.9.2 This Superintendent shall have full and complete authority** to act on behalf of the Contractor in all matters related to this project, except as defined in written form by the Contractor and accepted in writing by the Owner. All instructions given to the superintendent shall be considered as given to the Contractor.
 - **'8.9.3 The superintendent shall not be changed** except under the following circumstances:

- **'8.9.3.1** where the superintendent proves to be unsatisfactory to the Contractor or ceases to be in his employ, in which case the Contractor shall give timely <u>prior</u> written notice to the Owner of the impending change in superintendent and a reasonable explanation for the change; or
- **'8.9.3.2** where the Owner has reasonable grounds for dissatisfaction with the performance of the superintendent and gives written notice to the Contractor of these grounds. The Contractor, upon receiving such written notice, shall replace the existing superintendent with a successor, to whom the Owner has no objection.
- **'8.9.4 Should the Contractor not provide the superintendent as required by the Contract Documents to oversee all work being performed on this Contract**, the Owner has the right to deduct by Change Order the amount of General Conditions costs from the Contract Sum for the period in which proper Superintendence of the Work is not provided. This amount is determined by dividing the complete amount of General Conditions indicated in the approved Schedule of Values by the number of months of project duration according to the approved Project Schedule.
- **'8.10 Contractor's Project Manager.** In addition to the Superintendent required in article '8.9, the Contractor may employ a qualified, competent Project Manager. In the absence of an assigned Project Manager, the principal owner of the Contractor's Company shall be considered as the Project Manager. This Project Manager is not required be present on site at all times that Work of this contract is underway, but shall be intimately familiar with the status of the Work of the Project at all times. It shall be the responsibility of the Project Manager to supervise the Superintendent and represent the Contractor in all matters.
 - **'8.10.1 The Owner reserves the right to accept the Project Manager** selected by the Contractor. This Project Manager shall be qualified and experienced to manage the work of this Contract and represent the Contractor in all matters. The Contractor shall notify the A-E and Owner in writing for acceptance prior to any change in project management personnel. This change shall be for reasons outlined below.
 - **'8.10.1.1 The Contactor shall immediately replace a Project Manager upon written notice from the Owner that the current Project Manager is unsatisfactory.** The Owner has the right to require replacement of a Project Manager at any time that the Owner loses confidence in the Project Manager to adequately perform the duties required of the Contract Documents: to manage the Work in strict adherence to the Contract Documents; to maintain the project schedule; or to supervise the Superintendent. The Owner also has the right to require the replacement of the Project Manager for inappropriate or unprofessional conduct either on the project site or directed toward the A-E/ Engineer, the Owner's Representatives (DECA personnel), the Using Agency Representatives, or the general public.
 - **'8.10.2 This Project Manager shall have full and complete authority** to act on behalf of the Contractor in all matters related to this project. All instructions given to the Project Manager shall be considered as given to the Contractor.
 - **'8.10.3 The Project Manager shall not be changed** except under the following circumstances:
 - **'8.10.3.1** where the Project Manager proves to be unsatisfactory to the Contractor or ceases to be in his employ, in which case the Contractor shall give timely <u>prior</u> written notice to the Owner of the impending change in Project Manager and a reasonable explanation for the change; or

- **'8.10.3.2** where the Owner has reasonable grounds for dissatisfaction with the performance of the Project Manager and gives written notice to the Contractor of these grounds. The Contractor, upon receiving such written notice, shall replace the existing Project Manager with a successor, to whom the Owner has no objection.
- **'8.10.4 Should the Contractor fail to replace an unsatisfactory Project Manager as required by written notice of the Owner**, the Owner has the right to deduct by Change Order the amount of General Conditions costs from the Contract Sum for the period in which there is a refusal to make the required replacement. This amount is determined by dividing the complete amount of General Conditions indicated in the approved Schedule of Values by the number of months of project duration according to the approved Project Schedule.
- **'8.11 Temporary Support Facilities Required:** The Contractor shall provide temporary job offices for use by the Job Superintendent, A-E, Resident Observer (if applicable) and the Owner during the course of construction from the time of commencement of the Work until Substantial Completion. Provide electric, water, HVAC internet access and telephone for all areas of the temporary job office. This job office shall be large enough to accommodate project meetings and to provide for construction management operations. Where a Resident Observer is utilized on the project, a separate office shall be provided for the Resident Observer's use with electric, water, HVAC, telephone and internet access.

'9. Labor, Material, and General Contractor Warranty

- **'9.1 Contractor Provisions.** Unless otherwise stipulated, the Contractor shall provide and pay for all materials, supervision, labor, water, tools, equipment, light, power, temporary heat, hoist, supplies, appliances, transportation, and other facilities and things necessary for the execution and completion of the Work.
 - **'9.1.1 In the event the Owner elects to make available the electric power or domestic water, at no cost, to the Contractor for construction purposes,** the election to do so will be spelled out in the Special Conditions for this project. Available electric power provided by the Owner, at his election, shall not be utilized as a means for temporary heat without specific approval from the Owner in writing.
 - **'9.1.2** Additionally, the Owner reserves the right to cease to provide this available electric power and/or domestic water, at no cost to the Contractor, should it be found that the electric power and/or domestic water is not reasonably used economically.
- **'9.2 General Contractor Warranty.** The Contractor warrants to the Owner and A-E that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will strictly conform with the requirements of the Contract Documents.
 - **'9.2.1** The Contractor shall warrant all equipment, materials, products, and workmanship provided by the Contractor under these Contract Documents not only during the Contract period but also for a period of twelve (12) months after the Date of Final Completion.
 - '9.2.1.1 The One Year Warranty period for correction of Work shall be extended with respect to portions of the Work first performed after the Date of Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

- **'9.2.2** Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. While, the Contractor's warranty excludes remedy for damage or defect caused by abuse by the Owner or building occupants, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage, if the Work is not conforming to the requirements of the Work and that has been determined to be defective, is not excluded from the Contractor's One Year Warranty.
- **'9.2.3 If, during the Contract Period or during the One Year Warranty period** (a) any equipment, materials or products furnished and/or installed by the Contractor are found to be defective in service by reason of the Contractor's faulty process, structural and/or mechanical design or specification, or (b) any equipment, materials, or products furnished and/or installed by the Contractor are found to be defective by reason of defects in material or workmanship, the Contractor shall, promptly after receipt of written notice from the Owner or A-E, repair or cause to be repaired such defective equipment, materials or products, or replace such defective equipment, materials, or products.
 - **'9.2.3.1 During the One Year Warranty Period for correction of the Work, if the Owner fails to notify the Contractor** and give the Contractor the opportunity to make correction, the Owner waives the right to require correction by the Contractor and to claim a breach of Warranty. However, this inaction during the Warranty Period by the Owner does not imply any limitation of the Contractor's liability as indicated in paragraph '9.2.7.
 - **'9.2.3.2 During the One Year Warranty Period for correction of the Work, if the Owner notifies the Contractor** and gives the Contractor the opportunity to make correction, and the Contractor fails to correct the Work with reasonable promptness, the Owner has the right to claim a breach of Warranty.
- **'9.2.4 The Contractor's warranty shall not exclude** remedy for damage or defect caused by abuse by the Contractor, his subcontractors, or others within his control during the construction period or during work related to Contractor warranty.
 - **'9.2.4.1** Any portion of the Work required by the Contract Documents shall not be waived as a requirement for Completion of the Work, except by specific written authorization from the Associate Director of the Division of Engineering and Contract Administration for reasons where, by no fault of the Contractor, could not be completed within the time established for Completion of the Work.
- **'9.2.5 If during the Contractor's warranty period, there is a question concerning the quality or kind of materials and equipment installed in this project,** and requested by the A-E, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- **'9.2.6** In the event of multiple failures of major consequence in similar equipment, products, components or systems, prior to the expiration of the one-year warranty described above, the affected equipment, product, component or system shall be disassembled, inspected, and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered non-serviceable as a consequence of the equipment, product, component or system failure shall be replaced.
 - **'9.2.6.1** As used herein, multiple equipment, product, component or system failures shall be interpreted to mean two (2) or more successive failures of the same kind in the same item of equipment, product, component or system or

failures of the same kind in two (2) or more items of equipment or product, or in a specific building system or component.

- **'9.2.6.2 Major equipment failures may include,** but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts or structural members, broken or chipped gear teeth overheating, premature bearing failure, excessive wear, or excessive leakage around the seals.
 - **'9.2.6.2.1 Equipment failures which are directly and clearly traceable to operator abuse,** such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over or under lubrication and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the one-year warranty.
- **'9.2.6.3 Major product, component or system failures may include,** but are not limited to, failure of the item to perform as intended, excessive wear, discoloration due to defective finish application, leakage, or inadequacy of performance as specified.
 - **'9.2.6.3.1 Product, component, or system failures which are directly and clearly traceable to building user or operator abuse,** such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over or under lubrication, using maintenance procedures not conforming with published maintenance instructions, and abuse or vandalism, shall be exempted from the scope of the one-year warranty.
- **'9.2.6.4 Should multiple equipment, product, component or system failures occur** in a given item or type of equipment, product, component or system, all items of the same size and type shall be disassembled, inspected, modified or replaced, as necessary, and re-warranted for one year.
- **'9.2.6.5 A new twelve (12) month warranty against defective or deficient design, workmanship, and materials** shall commence on the day that the item of equipment is reassembled and placed back into operation.
- **'9.2.7 No specific provision of this Article nor any provision in the Contract Documents, nor any special guarantee time limit** implies any limitation of the Contractor's liability with the laws of the Commonwealth of Kentucky.
- **'9.3 Substitution Materials and Equipment.** Substitution of previously approved equipment and materials shall be submitted to the A-E for acceptance and will be considered only for the following reasons:
 - **'9.3.1** unavailability of the material or equipment due to conditions beyond the control of the Contractor
 - '9.3.2 inability of the supplier to meet Contract schedule; or
 - **'9.3.3** technical and immaterial noncompliance to specifications.

Inclusion of a certain, make or type of materials or equipment by the Contractor shall not obligate the A-E or Owner to accept such material or equipment if it does not meet the requirements of the plans and specifications.

Substitutions not properly approved and authorized by the A-E and Owner may be considered defective work. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials and equipment.

'9.4 Recycled Content: KRS 45A.520 mandates that every state agency require a minimum recycled content for those materials it purchases. In accordance with 200 KAR 5:330, all listed products are to be offered by the awarded contractor ONLY as a recycled product. Except as provided in KRS 45A.510, construction related materials requiring a minimum recycled content include Building Insulation, Aluminum products, concrete, cement and steel products. For a complete listing of those items requiring minimum recycled content please refer to 200 KAR 5:330 http://www.lrc.state.ky.us/kar/200/005/330.htm

'10. Surveys, Permits, Fees, Notices, and Tests

- '10.1 Owner-Furnished Surveys. The Owner shall furnish whatever surveys are specifically required by the Contract Documents. Approvals, assessments, easements for permanent structures or permanent changes in existing facilities, and utility tap-on fees shall be secured and paid for by the Owner, unless otherwise provided in the Contract Documents.
 - '10.1.1 Prior to start of Construction, the Owner will furnish all land and rights-of-way necessary for the carrying out and completion of the Work to be performed under this Contract, except as outlined in the Special Conditions should any conditions exist at the start of construction which does not make this possible at the start of construction.
- '10.2 Permits. Building, sewer, and water permits and similar kinds of permits required by local ordinances shall be obtained by the General Contractor. Note: no building permit fee shall be charged to or paid by the Contractor as the Commonwealth is exempt from such charges levied by Local Government Jurisdictions. The Contractor shall procure and pay for any necessary licenses to do business in the locale of the Work.
- **'10.3 Notices.** The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities bearing on the performance of the Work.
- '10.4 Required Regulatory Tests and Inspections. Regulatory agencies of the State and Federal governments having jurisdiction may require any Work to be inspected, tested or approved. The Contractor shall assume full responsibility therefore, including related costs, unless otherwise noted, and shall furnish the A-E the required certifications of inspection, testing or approval.
 - '10.4.1 The Contractor shall pay the electrical inspection fees directly to the Commonwealth of Kentucky, Department for Housing and Building Construction. The Electrical subcontractor is responsible for the payment of this fee. The Electrical subcontractor is responsible for coordination of the required electrical inspections as required by the Department for Housing and Building Construction.
- '10.5 Any delays by governmental agencies in obtaining Permits, Notices, Required Regulatory Tests and Inspections (10.2, 10.3, 10.4) and not the fault of one of the parties shall be shared by the Contractor and Owner with appropriate time extensions only. Liquidated damages and Contractor compensation for such delays or impact are not applicable and shall not be payable.
- '10.6 Payment for Tests. Tests of materials, products and equipment in place, required by the A-E or the Owner, to prove quality standards shall be paid by the Contractor. Should results of testing indicate that construction is not in compliance with Contract Documents, the Contractor shall bear the cost of any additional tests of the materials, products or equipment.

- '10.6.1 The Contractor shall give the A-E timely notice of readiness of the Work for all inspections, tests or approvals. This timely notice of readiness shall be no less than 72 hours except by prior agreement between the A-E and the Contractor.
- '10.7 Local Building Permits and fees. The Commonwealth's Construction projects are exempt from Building Permit requirements of Local Governments. The Contractor is not obligated to obtain a local building permit or to pay a building permit fee. However, this exemption does not waive the requirement for fees to make connection to utilities owned by a local municipality, Local Health Department Fees, or other such requirements.

'11. Protection of Work, Property, Employees and Public

- **'11.1 Safety Precautions and Programs.** The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Project. The Contractor shall be responsible for compliance with all State and Federal OSHA rules and regulations.
- '11.2 Safety of Persons and Property. The Contractor shall continuously maintain adequate protection of all Work from damage and shall protect the Owner's property from injury or loss arising in connection with this Contract. He shall make good any such damage, injury, or loss, except such as may be directly due to errors in the Contract Documents or caused by agents or employees of the Owner. He shall adequately protect adjacent property as provided by law and the Contract Documents.
 - **'11.2.1 The Contractor shall take all necessary precautions** for the safety of his employees and the employees of his subcontractors on the <u>Work site</u>, and shall comply with all applicable provisions of federal, state, and municipal safety laws and building codes to prevent accidents or injury to persons on, about, or adjacent to the premises where the Work is being performed.
 - '11.2.2 The Contractor shall provide and maintain a Work environment and procedures which will safeguard the public and State personnel and agents, property, material, supplies and equipment exposed to Contractor operations and activities; avoid interruptions of user agency operations; and avoid delays in Contract completion dates.
 - '11.2.2.1 Utilities which serve occupied building(s) shall not be interrupted unless absolutely necessary. When temporary utility interruptions are necessary, the Contractor shall provide the A-E and Owner a notice seven (7) calendar days prior to the temporary interruption. Where it is not practical to provide a seven (7) calendar day notice, the Contractor shall notify the A-E and Owner of the temporary interruption in advance and confirm the actual utility outage/ interruption a MINIMUM of seventy-two (72) hours ahead of the outage/ interruption.
 - **'11.2.2.2 When utilities are accidentally interrupted that serve occupied building(s),** the Contractor shall immediately notify the A-E, the Owner and the Building Operations Representative, and work consistently and persistently to restore the utilities immediately. The Contractor will be responsible for any costs or damages incurred by the Owner or adjacent property owners in the event of an accidental interruption.
 - '11.2.3 For the purposes of protecting the safety of persons and property, the Contractor shall provide appropriate safety barricades, signs and signal lights; Comply with any safety requirement published by any governmental authority with jurisdiction over the

site, including Federal, State or local jurisdictions; and ensure that any additional measures which are reasonably necessary for these purposes are taken.

- **'11.2.4 The Contractor shall designate a responsible member** of his organization present on the Work site as safety officer whose duty shall be to enforce safety regulations. The name and position of the person so designated shall be reported to the A-E by the Contractor at the beginning of the project. Should the Contractor have reason to change the responsible member designated with this task, he shall immediately inform the A-E in writing.
- **'11.2.5 In an emergency affecting the safety** of life, or of the Work, or of adjoining property, the Contractor, without special instruction or authorization from the A-E or Owner, shall act at his discretion to prevent such threatened loss or injury. Immediately following the emergency, the Contractor shall file a written report to the A-E and Owner detailing the incident and the actions taken to mitigate the condition.
- '11.2.6 If the A-E or the Owner becomes aware of any noncompliance by the Contractor with the safety conditions of this Contract or of any condition caused by the Contractor, which poses a serious or imminent danger to the health or safety of the public or to State personnel, they shall notify the Contractor orally, with written confirmation, and direct immediate initiation of corrective action.
 - '11.2.6.1 This provision of providing notice to Contractor for noncompliance with safety issues does not in any way relieve the Contractor from his responsibilities, either in part or in full, to provide adequate precautions to insure the safety of persons and property.
 - '11.2.6.2 This Notice, when given to the Contractor or his representative at the Work site, shall be deemed sufficient notice of noncompliance and that corrective action is required.
 - **'11.2.6.3 After receiving the Notice,** the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the A-E may issue an order stopping all or part of the Work until satisfactory corrective action has been taken.
 - **'11.2.6.3.1 The Contractor shall not be entitled** to an equitable adjustment of the Contract price or an extension of the performance schedule by reason of the issuance of any stop Work order under this Article.
- '11.3 Hazardous Materials. In the event the Contractor unexpectedly encounters on the site material reasonably believed to be asbestos, lead based paint, polychlorinated biphenyl (PCB) or other classified hazardous substances/materials which have not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner and A-E in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner and Contractor if in fact the material is asbestos, lead based paint, polychlorinated biphenyl (PCB), or other classified hazardous substances/materials which have not been rendered harmless. The Work in the affected area shall be resumed in the absence of any classified hazardous substances/materials or when it or they have been rendered harmless.
 - '11.3.1 The Contractor shall at all times safely guard the Owner's property and adjacent property from injury and/or loss resulting from the release of hazardous or toxic materials, or similar damage in connection with the Contract Documents or the performance of the Work hereunder. The Contractor shall replace or make good any damage, loss or injury caused as a result of failure to comply with Contract Documents.

'12. Inspection of Work / Defective or Incomplete Work / Special Inspections

The Owner, the A-E, Special Inspector Agency and their representatives shall at all times have access to the Work whenever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection. This access shall include access to approved Construction Documents and Submittals. The Contractor shall be given timely notification in order to arrange for proper inspection of any Work performed outside of the normal working day or week.

- '12.1 If the specifications, the A-E's instructions, laws, ordinances, or any public authority require any Work to be specially tested or approved, the Contractor shall give the A-E timely notice of its readiness for inspection. Inspections by the A-E shall be made promptly, as defined by the Contract between the Owner and the A-E.
- '12.2 In the event that the Contractor covers, conceals or obscures its Work in violation of the Contract or in violation of a directive from the Owner or the A-E, such Work shall be uncovered and displayed for the Owner's or A-E's inspection upon request, and shall be reworked at no cost in time or money to the Owner.
 - '12.2.1 If any of the Work is covered, concealed or obscured in a manner not covered by the above paragraph, it shall, if directed by the Owner or the A-E be uncovered and displayed for the Owner's or A-E's inspection. If the uncovered Work conforms strictly to the Contract, the costs incurred by the Contractor to uncover and subsequently, replace such Work shall be borne by the Owner. Otherwise, such costs shall be borne by the Contractor.
- '12.3 The Contractor shall, at no cost in time or money to the Owner, correct Work rejected by the Owner or by the A-E as defective or failing to conform to the Contract. Additionally, the Contractor shall reimburse the Owner for all testing, inspections and other expenses incurred as a result thereof.
- '12.4 The Owner may, but shall in no event be required to, choose to accept defective or nonconforming Work. In such event, the Contract Price shall be reduced by the greater of (1) the reasonable costs of removing and correcting the defective or nonconforming Work, and (2) the difference between the fair market value of the Project as constructed and the fair market value of the Project had it not been constructed in such a manner as to include defective or nonconforming Work. If the remaining portion of the unpaid Contract Sum, if any, is insufficient to compensate the Owner for the acceptance of defective or nonconforming Work, the Contractor shall, upon written demand from the Owner, pay the Owner such remaining compensation for accepting defective or nonconforming Work.
- **'12.5 When Special Inspections are required** by Section 1704 of the Kentucky Building Code for any portion of the work, the following provisions shall apply:
 - '12.5.1 Special Inspector Agency or Special Inspector: An independent agency/ registered professional Contracted by the Owner, required by the Kentucky Building Code Chapter 17, and responsible for conducting special inspections and testing defined as such in the technical specifications for this project.
 - '12.5.1.1 The costs of the initial special inspections and testing shall be borne by the Owner by separate contract with the Special Inspection Firm.
 - '12.5.1.2 The costs of re-inspections and/or re-testing, should discrepancies be found, shall be paid by the Owner, but is recoverable by the Owner from the Contractor by a credit change order.

- '12.5.1.3 The costs of re-scheduling inspections and/or testing, where the Contractor through his lack of reasonable control of scheduling causes the Special Inspector to spend time in preparation for an inspection and/or test that did not occur as scheduled, shall be paid by the Owner, but is recoverable by the Owner from the Contractor by a credit change order.
- **'12.5.2 Contract Document Compliance:** Special Inspection and testing as defined in the technical specifications is for the purpose of verifying compliance with requirements specified or indicated. This does not relieve the Contractor of the responsibility for compliance with the Contract Document requirements.
 - '12.5.2.1 Should the Special Inspector identify through inspection and testing that a portion of the Work is not in compliance with the technical specifications, the Special inspector is to provide notice to the A-, Owner and Contractor concurrently that a deviation exists. The Special Inspection Firm does not possess the authority to modify the requirements of the technical specifications, but to inspect, test and notify of any non-compliance or deficiencies.
 - **'12.5.2.2 When a non-compliance or deficiency exists** as reported by the Special Inspection Firm, the A-E is to review the Special Inspection Report and, when necessary, issue a "Defective Work in Place Notice" to the contractor to require correction or modification.
 - '12.5.2.3 Should the Special Inspector consider that there are a potential issue with the requirements of the technical specifications due to discovered existing field conditions, the Special Inspector is to include such consideration in the Special Inspection Report for review and interpretation by the A-E. The decision of the A-E is final.
- '12.5.3 Notify the Special Inspector: The Contractor shall be responsible for notifying the Special Inspector and/or Special Inspection Agency regarding individual inspections required by the Contract Documents and coordinating the schedule of inspections and testing with the Contractor's approved construction schedule. Adequate notice shall be provided so that the Special Inspector has time to become familiar with the project.
- '12.5.4 Deficiencies: The Contractor shall be responsible to ensure that deficiencies are corrected and shall coordinate with the Special Inspector to ensure that the Special Inspector has observed the corrected deficiency prior to the work involved in the discrepancy being concealed or made inaccessible by subsequent work. Concealing or making inaccessible such deficiencies shall constitute another deficiency subject to removal to allow observation of the work involved in the initial discrepancy.
- '12.5.5 Reporting Requirements: The Special Inspection Agency/ Special Inspector shall keep records of all inspections and testing, re-inspections and re-testing, and other related events. The Special Inspector shall furnish inspection and testing reports to the Owner, Contractor, and A-Eing concurrently and as construction progresses. Reports shall be submitted immediately following each site visit, inspection and when determinations of results of off-site testing are available.
 - '12.5.5.1 Reports shall include date of issue; project title and number; name/ address/ telephone number of testing agency; dates and locations of samples and tests or inspections; names of individuals making tests and inspections; description of the work being tested or inspected; test and inspection method; specification section related to work; complete test or inspection data; test and inspection results; interpretation of results; all non-conforming items/ discrepancies observed and corrective actions implemented by the Contractor; re-testing and re-inspection

performed; ambient conditions at time of sampling, testing or inspection; comments or professional opinion on whether tested or inspected work complies with the Contract Documents and name/ signature of inspector with registration number.

- '12.5.6 Notification of non-conforming or deficiency of the Work: The Special Inspection Firm/ Special Inspector shall immediately bring non-conforming or discrepancy work to the attention of the Owner, A-E and Contractor. The A-E shall make a determination as to the need for correction.
 - **'12.5.6.1 If non-conforming or deficiency work is** not corrected in a timely manner or are about to be incorporated into the Work, the Special Inspector shall bring the non-conforming or discrepancy work to the immediate attention of the Authority Having Jurisdiction, Owner, Contractor, and the A-E, and that item shall be highlighted in the Special Inspector's written report.
 - '12.5.6.2 Defective Work in Place Notice: The A-E is to review the Special Inspector's report and when necessary shall issue a "Defective Work in Place Notice" and issue it through the Document Collaboration System. The Special Inspector shall cause the Notice to be posted at the Project Site regarding the noted discrepancies and which shall contain, at a minimum, the following information about the non-conforming item: 1) Description and exact location; 2) Reference to applicable detail of the approved Construction Documents (Drawings and Specifications); 3) name and title of each individual notified and method of notification; and, 4) Resolution or corrective action taken or to be taken.

'13. Royalties and Patents

The Contractor shall pay all royalties and license fees and shall defend all suits or claims for infringement of any patent rights and shall save the Owner harmless from loss on account thereof.

'14. Changes in the Work/ Change Orders

- '14.1 Change Orders. One or more changes to the Work within the general scope of the Contract may be ordered by Change Order. The Contractor shall proceed with any such changes, (including additions, reductions, deletions, other revisions), and same shall be accomplished in strict accordance with the following:
 - **'14.1.1 Change Order means a written order to the Contractor** executed by the Owner and the A-E after execution of the Contract, directing a change in the Work and may include a change in the Contract Price, or the Contract Time, or any combination thereof. There shall be no authorized changes in the Work which affect either Contract Price or Contract Time without a fully executed Change Order.
 - **'14.1.1.1 In specific instances where the progress of the Work would be negatively affected** by a delay in the Work while a fully executed Change Order is being processed.. Upon approval by the Associate Director of the Division of Engineering, and with an agreed to Contract Sum/Contract Time adjustment, the A-E may issue a written authorization to proceed with the proposed change (with the change in Contract Sum/ Contract Time clearly indicated) prior to the issuance and execution of the formal Change Order. Following this written authorization to proceed with the proposed change, the A-E will prepare and process for execution the required Change Order.

- '14.1.1.2 In these specific instances where a written authorization to proceed is provided prior to execution of the required Change Order, the action of the Contractor to proceed with the authorized work shall be deemed as agreement to the change for the Amount and Time extension indicated in the written notice to proceed with the change.
- '14.1.2 Any change in the Contract Sum or Contract Time resulting from a Change Order shall be determined by one of the following methods:
 - (1) by mutual agreement of a lump sum amount and/or Time adjustment between the Owner and the Contractor as evidenced by (a) the Change in the Contract Sum or Contract Time being set forth in the Change Order, (b) such change in the Contract Sum or Contract Time, together with any conditions or requirements relating thereto, being initialed by both parties and (c) the Contractor's execution of the Change Order;
 - (2) **by unit prices stated in the Contract Documents** or subsequently agreed upon by the Owner and the Contractor
 - (3) on a time and materials basis with a not to exceed price limitation, when the scope of the Work is not readily determined prior to the execution of the Work. Prior to the use of a time and materials basis, approval of the Associate Director of the Division of Engineering is required. Additionally, the Contractor must provide detailed labor and materials documentation of the Work once performed for the reconciliation of the time and materials basis cost of the work. The A-E shall monitor the Work performed by this basis during the execution of the work; or
 - (4) **If no mutual agreement occurs** between the Owner and the Contractor, the Change in the Contract Sum, if any, shall be derived by determining the reasonable actual costs or savings achieved resulting from revisions in the Work. This determination shall be made by the A-E, who has the responsibility of interpretation of the Contract Documents.
 - '14.1.2(4).1 When a determination by the A-E is required for a Change Order due to no mutual agreement being reached between the Owner and the Contractor, the provisions of paragraph '14.1.3 and '14.1.4 shall apply. Additionally, the Contractor shall not refuse the perform the Work indicated by the Change Order and shall execute the Work in a timely manner, even if the Contractor intends to protest the determination as provided in paragraph '3.4
- '14.1.3 Items (1), (3), and (4) above shall include a component for all overhead, profit, indirect costs or other items not to exceed fifteen percent (15%). Any such costs or savings shall be documented in the format and with such content and detail as the Owner or the A-E requires. The Contractor shall only receive one fifteen percent (15%) for the "jobsite overhead and profit" component whether such work be done by the Contractor or by his Subcontractor.
 - '14.1.3.1 Contractor's Overhead and Profit percentages shall be considered to include bonds and insurance, field and office supervisors and assistants (including Project Manager(s), Job Site Superintendent(s), Project Engineers and assistants, and Crew Foremen), Job Office and storage Trailers, sanitary facilities, communications (telephone and internet), temporary utilities, temporary facilities, testing, security, use of small tools, incidental job burdens, and general home office expenses and no separate allowance shall be made therefore.
 - '14.1.3.2 Assistants to field and office supervisors include all clerical, stenographic and general office help. Incidental job burdens include, but are not

necessarily limited to, office equipment and supplies, and conformance to OSHA requirements and no separate allowance shall be made therefore.

- '14.1.3.3 Items such as, but not necessarily limited to, review and coordination, estimating and expediting relative to contract changes are associated with field and office supervision and are considered to be included in the contractor's overhead and/or fee percentage.
- '14.1.4 For all charges relating to any Change Order, whether determined under subparagraph (2), (3) or (4) above, the following provisions shall apply:
 - (1) The Contractor shall keep and present in such form as the A-E may direct, a correct account of all items in such form comprising the net cost of such Work, together with youchers.
 - (2) The determination of the A-E shall be final (except as provided in paragraph '3.4) upon all questions of the amount and cost of Changes in the Work, and it shall include in such cost, the cost to the Contractor of all materials used, of all labor, common and skilled, or foremen, trucks and teams, and the fair rental of all machinery used and for the period of such use.
 - (3) If said Work requires the use of machinery not already upon the work or to be otherwise used upon the Work, then the cost of transportation of such machinery to and from the Work shall be added to the fair rental, but said transportation shall not cover a distance exceeding one hundred (100) miles.
 - (4) The A-E shall not include in the net cost of Work any cost or rental or small tools, or any portion of time of the Contractor or his Superintendent, or any allowance for the use of capital, or any additional bond premium, insurance cost applicable to the Work or any actual or anticipated profit, or any job or office overhead not previously mentioned, these items being considered as being covered by the added fifteen (15%) percent for the jobsite overhead and profit component.
 - (5) In all cases where Changes in the Work are covered by unit prices set forth in the Contract, the value of such Work shall be determined only upon the basis of such unit prices.
 - (6) **Pending final determination of value,** payments on Changes in Work shall be made only upon the estimate of the A-E.
- **'14.1.5** If the Contractor claims that any instructions by the A-E involve additional cost and/or time extension, he shall give the A-E written notice thereof <u>within a reasonable</u> time after the receipt of such instructions and before proceeding to execute the <u>change in Work.</u>
- **'14.1.6 No work related to a Change Order shall be undertaken without a fully executed Change Order.** However, should the Owner and Contractor agree that time is of the essence for the execution of said work, the Owner will issue through the A-E in writing a notice to proceed with the said work prior to the full execution of the Change Order. This notice is to be upon acceptance by the Associate Director of the Division of Engineering. This notice to proceed with said work will include an acceptance of the proposed pricing of the work or will indicate that the pricing of the work is still being negotiated.

- **'14.1.7** If the Owner and Contractor cannot agree on the effect of an ordered change on the adjustment to the Contract Sum or Contract Time, this matter may also be referred to the A-E for determination.
 - '14.1.7.1 If the Owner and/or Contractor do not agree with the A-E's determination regarding the valuation of a change, the related adjustment to the Contract Sum or to the Contract Time, the matter shall be subject to the disputes procedure set out in Article 3.4 and Article 26.
- '14.1.8 The execution of a Change Order by the Contractor shall constitute conclusive evidence of the Contractor's agreement to the ordered changes in the Work, the resulting Contract as thus amended, the Contract Sum and the Contract Time for performance by the Contractor. The Contractor, by executing the Change Order, waives and forever releases any claim against the Owner for additional time or compensation for matters relating to or arising out of or resulting from the Work included within or affected by the executed Change Order.
- **'14.1.9** The Contractor shall notify and obtain the consent and approval of the Contractor's Payment and Performance Bond sureties with reference to all Change Orders if such notice, consent or approval are required by the Owner, the A-E, the Contractor's sureties or by law. The Contractor's execution of the Change Order shall constitute the Contractor's warranty to the Owner that the sureties have been notified of, and consent to, such Change Order and the sureties shall be conclusively deemed to have been notified of such Change Order and to have expressly consented thereto.
- '14.2 Cash Allowance: It is understood that the Contractor has included in the Contract Price all allowances (see Article '30 for more information) so named in the Contract Documents and shall cause the Work so covered to be furnished and performed for such sums as may be acceptable to A-E and the Owner. The Contractor agrees that:
 - '14.2.1 The allowances include the cost to Contractor (less any applicable trade in counts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and
 - '14.2.2 The Contractor's cost for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances and no demand for additional payment on account of any of the foregoing will be valid; and
 - '14.2.3 Prior to final payment of the full amount of the allowance (on the schedule of values), an appropriate Change Order will be issued as recommended by A-E reflect actual amounts due the Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.
- **'14.3 Minor Changes.** The A-E may authorize minor changes in the Work which do not involve additional cost or extension of the Contract Time, and which are not inconsistent with the intent of the Contract Documents. Such changes shall be effected by a Field Order issued by the A-E to the Contractor and Owner concurrently, which shall be binding on the Owner and Contractor. The Contractor shall carry out such orders promptly.
 - '14.3.1 However, if the Contractor claims that a Field Order involves additional cost or a delay to completion of the Work, he shall give the A-E written notice thereof within a reasonable time after receipt of the Field Order. Otherwise, he shall be deemed to have waived any right to claim an adjustment to the Contract Sum or to the Contract Time.

'15 Project Records

15.1 All documents relating in any manner whatsoever to the Project, or any designated portion thereof, which are in the possession of the Contractor, or any Subcontractor of the Contractor, shall be made available to the Owner or the A-E for inspection and copying upon written request by the Owner.

Furthermore, said documents shall be made available, upon request by the Owner, to any state, federal or other regulatory authority and any such authority may review, inspect and copy such records.

Said records include, but are not limited to all drawings, plans, specifications, submittals, correspondence, minutes, memoranda, tape recordings, videos, or other writings or things which document the Project, its design, and its construction.

Said records expressly include those documents reflecting the cost of construction to the Contractor.

'15.2 The Contractor shall maintain and protect these documents for no less than ten (10) years after final completion of the Project, or for any longer period of time as may be required by law or good construction practice.

'16. Delays and Extensions of Time

- '16.1 It is agreed that time is of the essence for each and every portion of the resulting Contract and where under the Contract an additional time is allowed for the completion of any Work, the new time limit fixed by such extension shall be of the essence of the Contract. Provided, that the Contractor shall not be charged with liquidated damages or any excess cost when the delay in completion of the Work is due to:
 - (1) any preference, priority, or allocation order duly issued by the government:
 - (2) unforeseeable cause beyond the control and without the fault or negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unusually severe weather; or
 - (3) any delays of Subcontractors or suppliers occasioned by any of the causes specified in subsections (1) and (2) of this Article.
- **16.1.1 Delay that is NOT caused by the Owner or Contractor**, that delays the critical path of the project schedule, may result in extension of Contract Time but not an increase in Contract Sum. Such delay includes: Acts of God; Labor disputes/ Strikes; Freight embargos; Fire (when not attributable to act of Contractor); Unusual delays in deliveries (when not attributable to act of Contractor); Health epidemics that affect Contractor forces; and, Other causes beyond the control of the Contractor or Owner. Note: an increase of time caused by a delay that is NOT caused by the Owner or Contractor, does not constitute reason for an increase in Contract Sum.
 - **'16.1.1.1 The Contractor shall, within fifteen** (15) **calendar days of the occurrence** of the event that caused a delay not caused by the Owner or Contractor, notify the A-E and Owner in writing. The A-E shall ascertain the facts and extent of the delay and notify the Contractor within a reasonable time of its decision in the matter. Any change in the Contract Time resulting from any such claim shall be incorporated in a Change Order. Such a claim shall not result in an increase in Contract Sum.

- '16.1.1.1.1 Should the Contractor NOT provide written notification to the A-E and Owner within the prescribed period of time indicated above, the Contractor, by his failure to properly notify, forfeits the right to seek a Contract Time Extension for said occurrence.
- '16.1.1.2 Should the Owner determine that it is in the Owner's best interest to avoid an extension of Contract time due to a delay not caused by the Owner or Contractor, the Owner, through the A-E, may request the Contractor to provide a plan of action to mitigate the delay through changes in the sequence of operations or through an extended workday for specific trades that will mitigate the delay. In such instances, the Owner may elect to pay the Contractor reasonable and justified additional costs required to mitigate the delay in lieu of a contract time extension. This additional costs shall be limited to the overtime premium of the extended workday for specific trades or shall be limited to actual and proven costs of a change in sequence of operations.
- **16.1.2 Delay due to adverse weather conditions**: The Contractor shall have incorporated into the Project Schedule at the time of execution of the Contract for Construction all anticipated delay caused by normally occurring adverse weather. Adverse weather is that which normally occurring (as defined as the average of the preceding ten (10) years) according to the records of the National Oceanic Atmospheric Administration (NOAA).
 - **'16.1.2.1 When adverse weather exceeds** that which is normally expected, as defined above, and the Contractor is making a claim for delay due to adverse weather, the Contractor shall submit to the A-E and Owner the following at the Project Progress Meeting immediately following the month in which the excessive adverse weather occurred:
 - 1) Current weather data from NOAA for the project site which documents and proves that the adverse weather occurred at the project site on days in which work was scheduled to occur.
 - 2) Historical weather data from NOAA for the project site which documents and proves that the adverse weather that occurred at the project site was more than anticipated.
 - 3) Contractor's daily field reports showing that the adverse weather that was experienced at the project site caused delay in the work that was scheduled to be performed on during the period in which adverse weather was experienced.
 - 4) Contractor's written detailed explanation of the delay in the work and how it was caused by the abnormal adverse weather that was experienced at the project site and was beyond the ability of the Contractor to control or mitigate the delay for each occurrence.
 - '16.1.2.1.1 Should the Contractor NOT provide the information indicated above to the A-E and Owner, within the prescribed period of time indicated above, the Contractor, by his failure to properly notify, forfeits the right to seek a Contract Time Extension for said occurrence.
 - '16.1.2.1.2 When the Contractor is behind the critical path of the schedule, it shall be the determination of the A-E as to whether the Contractor should be eligible for a time extension due to adverse weather delay. In making this determination, the A-E shall determine and conclude that the Contractor would have been delayed by adverse weather had the Contractor been on schedule of the critical path before determining that the Contractor is eligible for a time extension due to adverse weather delay. The Contractor shall provide evidence to the A-E for the A-E's use in making such determination.

- '16.1.2.2 When adverse weather is significantly less than that which is normally expected, as defined above, the A-E will prepare for the Owner, at its request, a claim for a reduction in Contract Time by providing current and historical weather data from NOAA for the project site which documents and proves that the adverse weather was less than anticipated at the Project Progress Meeting immediately following the month in which the adverse weather that occurred was significantly less than anticipated. The number of days in the claim shall be added to the project float and is made available to the Contractor and/or Owner to mitigate other types of delay in the project completion. Generally, a reduction of time caused by less than anticipated adverse weather does not constitute reason for a decrease in Contract Sum.
- **16.1.2.3** When the A-E determines that adverse weather has delayed the project and that the claim of the Contractor for delay due to adverse weather is justified, the Contractor will provide an accounting of float held in the project (see Article 16.2.1.4.1) that may be applied to the weather delay. Should the amount of weather delay exceed the available amount of float held on the project, the A-E will issue a Change Order extending the Contract Time by the number of days in which the Contractor was actually delayed due to adverse weather. Generally, an extension of time for delays caused by adverse weather does not constitute reason for an increase in Contract Sum.
 - '16.1.2.3.1 Should the Owner determine that it is in the Owner's best interest to avoid an extension of Contract time due to a delay caused by adverse weather, the Owner, through the A-E, may request the Contractor to provide a plan of action to mitigate the delay through changes in the sequence of operations or through an extended workday for specific trades that will mitigate the delay. In such instances, the Owner may elect to pay the Contractor reasonable and justified additional costs required to mitigate the delay in lieu of a contract time extension. This additional costs shall be limited to the overtime premium of the extended workday for specific trades or shall be limited to actual and proven costs of a change in sequence of operations.
- '16.2.1 Delay that is caused by the Owner, that delays the critical path of the project schedule, may result in extension of Contract Time and may result in an increase in Contract Sum. Generally, delays of this type which do not delay the critical path of the project schedule shall not result in extension of Contract Time nor result in an increase in Contract Sum.
 - **'16.2.1.1** The Contractor shall, within seven (7) calendar days of the occurrence of the event, notify the A-E in writing. The A-E shall ascertain the facts and extent of the delay and notify the Contractor within a reasonable time of its decision in the matter. Any change in the Contract Time resulting from any such claim shall be incorporated in a Change Order.
 - '16..2.1.1.1 Should the Contractor NOT provide the information indicated above to the A-E and Owner, within the prescribed period of time indicated above, the Contractor, by his failure to properly notify, forfeits the right to seek a Contract Time Extension for said occurrence.
 - **'16.2.1.2** An extension of time shall not be construed as cause for extra compensation under the Contract. Extensions of time relating to concealed conditions as defined in Article 26 shall be governed by the provisions of that Article.
 - **'16.2.1.3 Should the Contractor claim that an extension of time is cause for extra compensation under the Contract,** he shall make such claim in writing to the A-E within fifteen (15) calendar days of the occurrence of the event. This claim shall be in sufficient detail to support the Contractor's claim. In instances where the final determination of the costs associated with such delay is not readily calculable, the Contractor shall provide an ESTIMATED cost of the delay per day of delay. If this estimated cost of delay per day is

accepted by the Owner, the actual amount compensable by the delay will be based on this estimate.

- **16.2.1.3.1** A Contractor's claim for extra compensation under the Contract may include: Job Office expenses (for a delay in access of sixteen (16) calendar days in any given month / each month considered separately), extended equipment-left-idle costs (rented or owned), increased labor and material costs (for extended delays), loss of efficiency (for extended delays), increased insurance premiums, excess storage costs, etc.
- 16.2.1.3.2 A Contractor's claim for extra compensation under the Contract shall not include: home office costs, equipment-not-left-idle costs (rented or owned), increased labor or material costs (for short delays), job site forces costs, loss of efficiency (for short delays), etc.
- **'16.2.1.4 When the Contractor experiences a delay caused by the Owner**, the Contractor shall work to mitigate the delay to be best of his ability and to make a claim for the delay must prove that he mitigated the delay to the greatest extent possible.
 - 16.2.1.4.1 Since the Owner and Contractor share as a commodity, all float (including Total Float, Free Float and Sequestered Float) (See Article '4.2), this float is available to the Owner to mitigate the effect of events that may delay performance or completion of all or part of the Work that has been caused by the Owner.
- **16.2.1.5** When the Contractor experiences a delay caused by the Owner, the delay must result in a delay to the critical path of the project schedule which is not readily recoverable by the Contractor without actual damage. In making a claim for the delay the Contractor must prove that the delay was a delay to the critical path of the project schedule and that he was not readily able to recover without actual damage.
- **16.2.1.6** When the Contractor experiences a delay caused by the Owner, the Contractor may not be entitled to a claim for the delay if a concurrent delay is present that is caused by the actions or inaction of the Contractor. When a concurrent Contractor caused delay exists, both delays shall be reviewed together and the Contractor is only eligible to make a claim for a delay caused by the Owner that extends beyond the concurrent delay caused by the Contractor.
- **16.2.1.7** When there is a delay caused by the Contractor that is concurrent with a delay caused by the Owner, there may be an extension of Contract Time, if found warranted, but no compensation to the Contractor will be made.
- **16.2.1.8** When the Contractor is behind the accepted Project Schedule (related to the Critical Path), and there occurs a delay caused by the Owner (that would have affected the Critical Path had the Contractor been on schedule), no time extension or compensation will be due the Contractor during the period of time that he is behind schedule.
- 16.2.1.9 When the Contractor fails to plan his work in a manner than permits him to ask questions of the A-E/Owner reasonable ahead of the time he requires to the answer to avoid a delay caused by the Owner, the delay will be a considered a concurrent delay and while an extension of time may be found as reasonable to grant the Contractor, no compensation for the delay will be provided. This situation is considered a concurrent delay since the Contractor participated in creation of the delay by his failure to plan the work adequately to avoid or reduce the delay.

'17 Subcontractors

- **'17.1 Contractor Fully Responsible for Subcontractors.** The Contractor is fully responsible to the Owner for the acts and omissions of his Subcontractors and of persons and entities either directly or indirectly employed by them. Nothing contained in the Contract Documents shall create any contractual relationship between the Owner and a Subcontractor.
 - '17.1.1 The Contractor has the contractual obligation to adjust differences between his several Subcontractors. Attempts to have the A-E and/or Owner settle disputes between the Contractor and his Subcontractors or between Subcontractors will not be given consideration.
 - '17.1.2 The Contractor shall not submit any claim from a Subcontractor to the A-E and/or Owner. Should the Contractor receive a claim from a Subcontractor, it is his obligation to satisfy the claim with his subcontractor. Should the Contractor determine that a claim from a Subcontractor is valid and should be considered by the A-E and/or Owner, the Contractor shall make the claim as himself with the subcontractor's claim as supporting documentation. The Contractor shall also provide documentation and reason for supporting the claim to the A-E and/or Owner.
 - '17.1.2.1 The A-E and/or Owner have no responsibility or obligation to meet with a subcontractor to resolve a dispute or claim. Should the Contractor desire to have a subcontractor accompany the Contract in a meeting to resolve a dispute or claim, a request shall be made prior to the meeting requesting the Owner's acceptance of such accompaniment. Granting of this acceptance shall be solely at the discretion of the Owner and does not establish any contractual relationship of the Owner with the subcontractor in any respects.
 - '17.1.3 The Contractor is responsible for the performance of his several subcontractors including, but not necessarily limited to: any delay in completion of the work of a subcontractor; sequencing of work among his several subcontractors; covering up of work requiring inspection or observation; and/or the quality of workmanship in completing the Work.
 - '17.1.4 The Contractor shall not submit to the A-E and/or Owner any document, submittal, manual, or price proposal directly from his several Subcontractors without first having reviewed such and determined that it is reasonable, complete, and compliant with the Contract Documents.
- '17.2 Flow-down Requirement. By contract, the Contractor shall require each Subcontractor:
 - (1) to be bound to the Contractor by the terms of the Contract Documents insofar as they apply to the Work to be performed by the Subcontractor; and
 - (2) to assume toward the Contractor all the obligations which the Contractor, by the Contract Documents, assumes toward the Owner.
- '17.3 Contracts with Subcontractors. The Contractor shall contract with those Subcontractors listed in the Contractors Bid Response and deemed acceptable by the Owner in accordance with the procedure outlined in the Instruction to Bidders. All subcontracts shall afford the Contractor rights against the Subcontractor which correspond to those rights afforded to the Owner against the Contractor herein, including those rights of Contract termination as set forth herein.
- '17.4 Substitution of Subcontractors. The Contractor shall not contract with any substitute Subcontractor or change a Subcontractor without providing timely written notice of the

proposed substitution to the A-E and Owner. The substitution shall not be made if the A-E and Owner object in writing to such change.

- **17.4.1 Release required of original Subcontractor.** When the Contractor finds it necessary to propose a substitute Subcontractor or change a Subcontractor he shall provide to the Owner a written release from the Subcontractor being substituted or changed indicating that they are not able, or not willing to, provide the work in which they were originally contracted to provide.
 - **17.4.1.1** This written release shall be on the official letterhead of the **Subcontractor**, when obtainable, stating that the Subcontractor is agreeable to being substituted on the project and that the Subcontractor waives all current and future claims resultant from the substitution.
 - **17.4.1.2** When the Contractor cannot obtain the release required of original Subcontractor he shall provide in written form a statement, on the letterhead of the Contractor with proof that the Contractor has attempted to obtain such a release, that the Subcontractor is non-responsive in not only providing the release but is also non-responsive in providing the work being subcontracted, and that the Contractor fully accepts any future liability from the original subcontractor making a claim related to being substituted.
 - **17.4.1.3 Prior to the substitution being made,** the Contractor shall obtain written approval from the Purchasing Officer indicating that the Commonwealth has reviewed the documents provided as indicated above and has concluded that it is in the best interests of the Commonwealth that such a substitution is accepted.

'18. Payment

The Owner shall make payments, less held retainage (defined in paragraph 18.5), to the Contractor on the amount of the Work performed or materials furnished for the Work in accordance with the following procedures:

- **18.1 Schedule of Values.** At the same time it submits a construction schedule, within fifteen (15) days of the Date of Commencement, as provided in Article 4, the Contractor shall submit a Schedule of Values apportioning the Contract Sum among the different elements of the Project for purposes of periodic and final payment, prepared in such form and supported by such data to substantiate its accuracy as the A-E may require. The Contractor shall not imbalance its Schedule of Values, nor artificially inflate any element thereof. The violation of this provision by the Contractor shall constitute a material breach of the Contract. Upon written approval by the A-E and the Owner, the Schedule of Values and construction schedule shall become the basis for the Contractor's Payment Requests during construction.
- '18.2 Application for Progress Payment. Not more often than once a month (except as provided in paragraph 3.8), the Contractor shall submit to the A-E a signed application for payment (sometimes referred to as Payment Request), for the Work completed as of the date of the application and accompanied by such data and schedules as the A-E may reasonably require.
 - **'18.2.1 Therein, the Contractor may request payment less held retainage**, of that part of the Contract Sum allocable to Contract requirements properly provided, labor, materials and equipment properly incorporated in the Project.
 - **'18.2.2 If payment is requested on the basis of materials and equipment not incorporated in the Project,** but delivered and suitably stored at the Project site or at another location agreed to in writing by the Owner, the application for payments shall also

be accompanied by such data, satisfactory to Owner, as will establish the Owner's title to the material and equipment and protect his interest therein, including written documentation of full insurance against loss or damage and the bonding of the storage sites. Storage sites must be bonded.

- **'18.2.3 Each subsequent application for payment** shall include an affidavit of the Contractor stating that all previous progress payments received on account of the Work have been applied to discharge in full all of the Contractor's obligations reflected in prior applications for payment.
- **'18.2.4 Each Payment Request shall be signed by the Contractor** and shall constitute the Contractor's representation that the quantity of Work has reach the level for which payment is requested, that the Work has been properly installed or performed in strict compliance with this Contract, and that the Contractor knows of no reason why payment should not be made as requested.
- **'18.3 Approval of Payments.** The A-E shall review the application for payment and shall review the work at the Project site or elsewhere to determine whether the quantity and quality of the Work is as represented in the application for payment and is as required by this Contract.
 - **'18.3.1 The A-E shall, within ten (10) business days** after receipt of each application for payment, approve in writing the amount which, in the opinion of the A-E, is properly owing to the Contractor.
 - '18.3.1.1 When there is reasonable justification that causes the A-E to be unable to perform this review, approval and submission of his recommendation to the Owner within the time prescribed in paragraph 18.3.1 above, the A-E will notify the Contractor in writing as to the justification and as to the time that will be required for this review, approval and submission of his recommendation to the Owner.
 - '18.3.2 The Owner shall make payment to the Contractor within twenty (20) business days following the A-E's written approval of each application for payment. A reasonable delay on the part of the Owner in making payment to the Contractor for any given payment shall not be a breach of contract.
 - '18.3.2.1 When there is reasonable justification that causes the Owner to be unable to make payment within the time prescribed in paragraph 18.3.2 above, the Owner will notify the Contractor in writing as to the justification as to why this payment cannot be made.
 - '18.3.2.2 The Owner will not be required to make payment to the Contractor within the time prescribed in paragraph 18.3.2 above, when the Owner has justification for the holding of this payment such as when the Owner's payment is conditional on submission of required documents from the Contractor.
 - **'18.3.3** The amount of each such payment shall be the amount approved for payment by the A-E less such amounts, if any, otherwise owing by the Contractor to the Owner or which the Owner shall have the right to withhold as authorized by this Contract. The A-E's approval of the Contractor's application for payment shall not preclude the Owner from the exercise of any of its rights as set forth herein. The Contractor warrants and represents that, upon payment of the application for payment, title to all Work included in such payment shall be vested in the Owner.
- '18.4 Contractor's Warranty of Title. The Contractor warrants and guarantees that title to all Work, materials and equipment covered by any application for payment, whether incorporated

in the project or not, will pass to Owner at the time of payment free and clear of all encumbrance.

- '18.5 Held Retainage/Retainage Reduction. Until fifty percent (50%) of the construction work has been completed in accordance with the contract, the Owner may withhold no more than ten percent (10%) retainage from the amount of any undisputed payment due, and retainage held after fifty-one percent (51%) of the construction project has been completed shall not be more than five percent (5%) of the total Contract Sum.
 - **'18.5.1 Subsequently, the Contractor shall withhold no more than** ten percent (10%) retainage from the amount of any undisputed payment due to a subcontractor, and retainage held after fifty-one percent (51%) of the construction project has been completed shall not be more than five percent (5%) of the total amount contracted with a subcontractor.
- **'18.6 Completion, Acceptance and Final Payment.** Upon certification by the A-E of Substantial Completion of the Work, the Contractor shall continue to make normal pay requests as defined within this document.
 - '18.6.1 Within thirty (30) calendar days after substantial completion or within twenty (20) calendar days after receipt of the A-E's recommendation for payment (whichever comes last), the Owner shall release the retainage less an amount equal to two hundred percent (200%) of the Owner's reasonably estimated cost of the balance of any contractor's contractually obligated, yet uncompleted, work remaining plus the following:
 - **'18.6.1.1 Should the Contractor not fulfill the requirements for Substantial Completion** by the date established by the Contract Documents for Substantial Completion, the Owner may withhold an additional amount of retainage to cover the anticipated application of "Liquidated Damages" or "Damages for Untimely Performance".
 - '18.6.2 Final payment shall be made by the Owner to the Contractor when the Contract has been fully performed by the Contractor in accordance with the Contract Documents and a final Certificate of Payment is submitted by the A-E to the Owner. Such final payment shall be made by the Owner not more than twenty (20) calendar days after the submittal by the A-E of the final Certificate of Payment, except:
 - '18.6.2.1 when the Owner is anticipating applying "Liquidated Damages" or "Damages for Untimely Performance", the amount of this anticipated application of damages may be withheld from Final Payment until such damages are resolved between the Owner and the Contractor.
 - **'18.6.3 The Contractor shall submit with the application for final payment** an affidavit that all payrolls, bills for materials, supplies and equipment, and other indebtedness connected with the Work have been paid or otherwise satisfied, along with such supporting evidence of payment as the A-E requires. Final payment is conditioned on satisfactory compliance with this requirement.
- '18.7 Waiver of Claims. The making of final payment shall constitute a waiver of all claims by the Owner except those arising from:
 - '18.7.1 unsettled liens:
 - '18.7.2 faulty or defective Work appearing after Substantial Completion;
 - '18.7.3 failure of the Work to comply with the requirements of the Contract Documents; or
 - '18.7.4 terms of any special warranties required by the Contract Documents.

The acceptance of final payment by the Contractor shall constitute a waiver of all claims except those previously made in writing and identified by the Contractor as unsettled at the time of the final application for payment.

- '18.8 Contractor's Payment to Subcontractors. Within fourteen (14) calendar days of when payment is received from the Owner, the Contractor shall pay all Subcontractors, materialmen, laborers and suppliers the amounts they are due for the Work covered by such payment.
 - '18.8.1 In the event the Owner becomes informed that the Contractor has not paid a Subcontractor, material-man, laborer, or supplier as provided herein, the Owner shall have the right, but not the duty, to issue future checks and payment to the Contractor of amounts otherwise due hereunder naming the Contractor and any such Subcontractor, material-man, laborer, or supplier as joint payees. Such joint check procedure, if employed by the Owner, shall create no rights in favor of any person or entity beyond the right of the named payees to payment of the check and shall not be deemed to commit the Owner to repeat the procedure in the future.
 - **'18.8.2** The Contractor shall, by an appropriate agreement with each Subcontractor, require each Subcontractor to make payment to his subcontractors in similar manner.
 - **'18.8.3** The A-E or Owner may, on request, furnish to any Subcontractor information regarding the percentage of completion of the amounts applied for by the Contractor and the action thereon by the A-E.
 - **'18.8.4** Neither the Owner nor the A-E shall have any obligation to make payment to any Subcontractor except as may otherwise be required by law.
- '18.9 Owner's Rights Relating to Payments. Neither payment to the Contractor, utilization of the project for any purpose by the Owner, nor any act or omission by the Owner shall be interpreted or construed as an acceptance of any Work of the Contractor not strictly in compliance with this Contract.
 - **'18.9.1 The Owner shall have the right to refuse to make payment** and, if necessary, may demand the return of a portion or all of the amount previously paid to the Contractor due to:
 - **'18.9.1.1** The quality of a portion, or all, of the Contractor's Work not being in accordance with the requirements of this Contract;
 - '18.9.1.2 The quantity of the Contractor's Work not being as represented in the Contractor's Payment Request, or otherwise;
 - '18.9.1.3 The Contractor's rate of progress being such that, in the Owner's opinion, substantial or final completion, or both, may be inexcusably delayed;
 - '18.9.1.4 Claims made, or likely to be made, against the Owner;
 - '18.9.1.5 Loss caused by the Contractor;
 - '18.9.1.6 The Contractor's failure or refusal to perform any of its obligations to the Owner under this Contract.

In the event that the Owner makes written demand upon the Contractor for amounts previously paid by the Owner as contemplated in this Paragraph, the Contractor must promptly comply with such demand.

'19. Completion

'19.1 Commencement and Completion of Work. The Contractor shall begin the Work on the Date of Commencement as specified in the Contract issued by the Owner.

- '19.1.1 The Contractor is expected to mobilize on site and begin work no later than fifteen (15) calendar days after the Date of Commencement, unless he has notified the A-E and Owner in writing of acceptable reasons why it is not in the best interest of the Commonwealth and the Project that he will not mobilize by that date.
- '19.1.2 The Contractor shall diligently and expeditiously continue the performance of the Contract continuously to and until Substantial Completion and Final Completion of the Project. All time limits stated in the Contract Documents are the essence of the Contract.
- '19.1.3 The Contractor shall accomplish the Work in accordance with the construction schedule (as provided in Article 4) so as to achieve Substantial Completion and Final Completion dates as defined in the Contract Documents.
- '19.2 Date for Commencement of Commissioning. Commissioning of specified building systems shall be scheduled to allow for the completion of the commissioning process by the Date of Substantial Completion. The Contractor shall work to complete the initial installation and startup of equipment involved in these building systems early enough in the project that the complete and properly conducted commissioning process can be completed including any corrective work and verification identified by the commissioning process. (See the associated sections of the technical specifications for the commissioning requirements and procedures for each building system which is to be commissioned).
- '19.3 Date for Commencement of Testing and Balancing. Testing and Balancing of HVAC systems shall be scheduled to allow for the completion of the Testing and Balancing process by the Date of Substantial Completion. The Contractor shall work to complete the initial installation and startup of HVAC equipment early enough in the project that the complete and properly conducted testing and balancing process can be completed including any corrective work and verification identified by the testing and balancing process.
- '19.4 Substantial Completion of the Work. The Substantial Completion Date shall be that date certified by the A-E, in consultation with the Owner, in accordance with the following procedures.
 - '19.4.1 "Substantial Completion" or "Substantially Complete" means the point in time when:
 - '19.4.1.1 The progress of the Work, or designated portion of the Work (as agreed in writing advance by the Owner, A-E and Contractor), is fully complete and functional in accordance with the requirements of the Contract Documents such that only items listed in the Punch list remain and the Work, or designated portion thereof, is ready to be occupied and/or utilized for its intended purpose;
 - '19.4.1.2 The applicable Governmental Authorities have issued a certificate of occupancy (or where Substantial Completion only applies to a designated portion of the Work, a temporary certificate of occupancy) and/or any other applicable approvals, licenses, certifications or other written evidence from the applicable Governmental Authority that said Work, or designated portion of the Work, has been completed to such authority's satisfaction and is ready to be occupied and/or used for its intended purpose.
 - '19.4.1.2.1 Where the project requires specialized Governmental Authorities to inspect and accept the construction (i.e. Office of Inspector General, Federal Agencies, etc.) a determination is to be made in the 'Special Conditions' of this Contract as to the timing of these

- inspections or acceptances and how they affect the Date of Substantial Completion, Date of Final Completion or an Extended Date for Compliance for that specific inspection or acceptance requirement.
- '19.4.1.3 The A-E has issued an Owner approved certificate of Substantial Completion for the Work, or designated portion of the Work, in accordance with the terms of the Contract Documents;
- '19.4.1.4 Operations and Maintenance Manuals, have been received for review by the A-E and the A-E has determined that the Operations and Maintenance Manuals are complete.
 - '19.4.1.4.1 Note that the Contractor shall submit Operations and Maintenance Manuals prior to the anticipated Date of Substantial Completion in order to allow the A-E reasonable time to review and approve or reject the submittal.
 - '19.4.1.4.2 The A-E shall review and approve or reject the Operations and Maintenance Manuals within fourteen (14) calendar days of receipt from the Contractor. The Date of Substantial Completion shall not be earlier than the date of approval of the Operations and Maintenance Manuals by the A-E.
- '19.4.1.5 Warranty Samples, have been reviewed and approved by the A-E.
 - '19.4.1.5.1 Note that the Contractor shall submit samples of each required Warranty prior to the anticipated Date of Substantial Completion in order to allow the A-E reasonable time to review and approve or reject the submittal.
 - '19.4.1.5.2 The A-E shall review and approve or reject the sample Warranties within fourteen (14) calendar days of receipt from the Contractor. The Date of Substantial Completion shall not be earlier than the date of approval of the samples of Warranties by the A-E.
- '19.4.1.6 With respect to all of the Project's building systems, including, without limitation, all systems being Commissioned, the Work, or designated portion of the Work (as agreed in writing in advance by the Owner, A-E and Contractor), is fully commissioned, balanced, tested and operational in compliance with the Contract Documents and applicable Laws ("Systems Commissioning"); The Date of Substantial Completion shall not be earlier than the date in which Systems Commissioning is completed.
- '19.4.1.7 All required initial and follow-up orientation and training has been accomplished in accordance with the requirements of the Contract Documents ("Systems Training"). The Date of Substantial Completion shall be no earlier than the date in which the final training session has been satisfactorily completed.
- '19.4.1.8 The Contractor shall have advised the Owner of insurance requirements including a list of all fixed and non-fixed equipment provided under the Work including replacement values for each item of equipment.
- '19.4.2 When the Contractor determines that Substantial Completion has been achieved, the Contractor shall notify the Owner and the A-E in writing. The notification shall be accompanied by a Contractor prepared list of those items of Work still to be completed or corrected. The failure of the Contractor to include any item or items on such list not completed or needing correction shall not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

- '19.4.3 The A-E shall, within a reasonable time after receipt of notification from the Contractor of Substantial Completion, make such inspection, with consultation of the Owner, to confirm that the Work has achieved Substantial Completion. If the Contractor's notification is not accompanied by the list provided in paragraph '19.2.1, the A-E and Owner may elect to postpone this inspection until receipt of the list proscribed.
- '19.4.4 Upon its confirmation that the Contractor's work is substantially complete, the A-E shall prepare a Certificate of Substantial Completion which shall establish the Substantial Completion Date and the responsibilities between the Owner and Contractor for security, maintenance, heat, utilities and insurance, if not otherwise provided for in the Contract Documents, and a tentative list of items to be completed or corrected, within thirty (30) calendar days from the Substantial Completion Date. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of the responsibilities assigned to them in the certificate.
 - '19.4.4.1 Should the A-E confirm that the Work has achieved Substantial Completion on the date of his inspection, the A-E shall derive that the Contractor was Substantially Complete on the date of receipt of the notification from the Contractor indicated above.
 - '19.4.4.2 When the Owner accepts Substantial Completion and occupies a building, all operations, maintenance, utilities and insurance become the responsibility of the Owner, except those items specifically identified in the Certificate of Substantial Completion as remaining to be completed by the Contractor.
 - **'19.4.4.3** If, after making the inspection, the A-E fails to find that the Contractor's Work has achieved Substantial Completion, he will notify the Contractor in writing, giving the reasons therefore.
 - **'19.4.4.4** If the A-E through its inspection fails to find that the Contractor's Work has not achieved Substantial Completion and is required to repeat all, or any portion, of its inspection, the Contractor shall bear the cost of such repeat inspections which cost may be deducted by the Owner from any payment then or thereafter due the Contractor. This deduction by the Owner from any payment for this reason will be by a credit to the Contract Sum by Change Order.
- **'19.5 Final Completion of the Work.** The A-E, upon receipt of written notice from the Contractor that the Work is finally complete and is ready for final inspection and acceptance, will promptly make such inspection and when he finds the Work completed and acceptable under the Contract Documents and the Contract fully performed, he will so notify the Contractor in writing, and the Contractor shall promptly issue a final Certificate of Payment to the Owner.
 - **'19.5.1** "Final Completion or "Finally Complete" means the point in time when:
 - '19.5.1.1 The progress of the Work, is fully complete and functional in accordance with the requirements of the Contract Documents such that no items listed in the Punch list remain uncorrected;
 - '19.5.1.2 The applicable Governmental Authorities have issued a final certificate of occupancy;

- **'19.5.1.3 The A-E** has issued an Owner approved certificate of Final Completion for the Work, in accordance with the terms of the Contract Documents:
- '19.5.1.4 Warranty Binder, have been reviewed and approved by the A-E.
 - '19.5.1.4.1 Note that the Contractor shall submit a binder with original copies of all required Warranties prior to the anticipated Date of Final Completion in order to allow the A-E reasonable time to review and approve or reject the submittal.
 - '19.5.1.4.2 The A-E shall review and approve or reject the Warranties within a reasonable time after receipt from the Contractor. The Date of Final Completion shall not be earlier than the date of receipt of the Warranty Binder by the A-E where the Warranty Binder is subsequently approved by the A-E.
- '19.5.1.5 With respect to all of the Project's building systems, including, without limitation, all systems being Commissioned, the Work, is fully commissioned without "Corrective Actions" remaining to be completed in compliance with the Contract Documents and applicable Laws ("Systems Commissioning"); The Date of Final Completion shall not be earlier than the date in which Systems Commissioning is fully completed including all "Corrective Actions".
- '19.5.1.6 The Contractor has submitted a final Application for Payment including a Final Affidavit as required by the Commonwealth.
- '19.5.1.7 The Contractor and the A-E have submitted to the Owner a report of the status of LEED Certification documentation when required by a project that is under LEED Certification. Included in these reports is a listing of documentation that will be required for the final LEED Certification during the one year warranty period.
- '19.5.2 Should the A-E confirm that the Work has achieved Final Completion on the date of his inspection, the A-E shall derive that the Contractor was Finally Complete on the date of receipt of the notification from the Contractor indicated above.
- '19.5.3 If the A-E is unable to issue its final Certificate of Payment and is required to repeat its final inspection of the Project, the Contractor shall bear the cost of such repeat inspection(s), which costs may be deducted by the Owner from the Contractor's final payment;
- '19.6 Use of Adequately Complete Portions. The Owner may use or occupy a specified portion of the Work at any stage, provided that:
 - '19.6.1 such use or occupancy is consented to by insurers and
 - '19.6.2 it is authorized by the issuance of a Temporary Certificate of Occupancy or a Certificate of Occupancy by public regulatory bodies having jurisdiction over the Work; and
 - **'19.6.3** prior to such use or occupation, the affected portion of the Work is jointly inspected by the Owner, Contractor and A-E to determine the precise stage of completion.
 - Such possession and use shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents. The Owner's use of adequately completed portions (with the Contractor's agreement), while the Work of

the Project is not actually Substantially Complete, shall not be deemed as a defining factor in determining that the Project has reached Substantial Completion.

'19.7 Liquidated Damages/ Damages from Untimely Performance

- '19.7.1 The Contractor shall pay the Owner an amount identified in the Contract Documents for each and every calendar day of unexcused delay in achieving Substantial Completion and Final Completion beyond the date set for each.
 - **'19.7.1.1 Any sums due and payable hereunder by the Contractor** shall be payable, not as a penalty, but as liquidated damages representing delay damages sustained by the Owner, estimated at the time of executing this Contract.
 - '19.7.1.2 When the Owner is able to determine an actual sum of Damages from Untimely Performance, and that sum is less than the predetermined "Liquidated Damages", the Owner may, upon review of the particular circumstances of this specific Project, elect to apply the lesser amount of damages.
- '19.7.2 When the Owner reasonably believes that Substantial Completion will be inexcusably delayed, the Owner shall be entitled, but not required, to withhold from any amounts otherwise due the Contractor an amount then believed by the Owner to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving Substantial Completion, or any part thereof, for which the Owner has withheld payment, the Owner shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages.
- '19.7.3 The Contractor shall not have the right without justifiable cause to contest the Owner's assessment of Liquidated Damages as defined by this Article and as indicated in the Special Conditions.
- '19.7.3.1 Should the Contractor believe he has justifiable cause for contesting the Owner's assessment of Liquidated Damages, once the project work has achieved <u>FINAL COMPLETION</u>, the Contractor may submit to the Director of the Division of Engineering and Contract Administration written detailed explanation of the justifiable cause for contesting the Owner's assessment of Liquidated Damages.
 - '19.7.3.1.1 Within fifteen (15) calendar days of the issuance of a Change Order which includes the Owner's assessment of Liquidated Damages, the Contractor shall provide written notification to the Director of the Division of Engineering and Contract Administration of the Contractor's intent to contest the Owner's assessment of Liquidated Damages. Failure of the Contractor to make such written notification shall cause the Owner to execute the Change Order which includes the Owner's assessment of Liquidated Damages.
 - '19.7.3.1.2 The Contractor's submission of the Final Application for Payment shall be evidence that the Contractor does not desire to contest the Owner's assessment of Liquidated Damages and shall be evidence of the Contractor's agreement with the Owner's assessment of Liquidated Damages.
 - '19.7.3.1.3 When the Director of the Division of Engineering and Contract Administration has reviewed the submitted evidence from the Contractor, gathered other evidence and information related to the Contractor's contesting of the Owner's assessment of Liquidated Damages, and made a determination as to the, reasonableness, validity

and standing of the Contractor's contesting, the Director shall issue a final determination in the matter.

'20. Correction of Work

- **'20.1 Correction of Work Prior to Final Payment.** The Contractor shall promptly correct Work which is rejected by the A-E as failing to conform to the requirements of the Contract Documents. Such correction shall be required regardless of whether or not the nonconformities are observed before or after Substantial Completion, or whether or not the work has been fully fabricated, installed or completed.
- **'20.2 Correction of Work After Final Payment**. Neither the Final Certificate of payment nor any provisions in the Contract Documents shall relieve the Contractor of responsibility for failure to conform to the requirements of the Contract Documents.
 - '20.2.1 If within one year after the date of Final Completion of the Work or designated portion thereof or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct the Work promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition.
 - '20.2.1.1 This period of one year shall be extended with respect to portions of Work first performed after Final Completion by the period of time between Final Completion and the actual performance of the Work. This obligation under this paragraph shall survive acceptance of the Work under the Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the conditions.
- **'20.3 Responsibility for Related Costs.** In addition to being responsible for correcting the Work and removing any nonconforming Work or materials which are not corrected from the jobsite, the Contractor shall bear all other costs of bringing the affected Work into compliance with the Contract Documents. These include costs of any required additional testing and inspection services, A-E's services, and any resulting damages to property or to construction Work of other contractors or of the Owner.
- **'20.4 Correction by Owner.** If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may take steps to correct the Work itself. If, within a ten (10) business day period after receipt of written notice to correct the nonconformity, the Contractor has not made serious efforts to correct the nonconformity, the Owner may without prejudice to any other remedies it may have, proceed to correct the non-conforming Work.
 - **'20.4.1** In such cases a Change Order shall be issued by the Owner with the approval of the A-E reflecting an equitable deduction from the Contract Sum to cover the cost of correcting the Work, including compensation for the A-E's additional services and other related expenses and damages. The amount of the Change Order shall be deducted from payments then or thereafter due the Contractor. If final payment has already been made, the Contractor shall pay the difference within a reasonable time, which is generally defined as 30 calendar days from the date of written request for such reimbursement by the Owner.
- **'20.5 Ongoing Liability of Contractor for Defective Work.** The foregoing provisions establishing the specific obligation of the Contractor to perform corrective Work do not establish a period of limitations on other obligations of the Contractor under the Contract Documents. Even after the Contractor is no longer specifically obligated to perform corrective Work itself, it

shall still be held liable for nonconforming Work and for other breaches of its obligations under the Contract Documents.

'20.6 Deduction for Uncorrected Work. If the Owner deems it not expedient to correct Work which is not in accordance with the requirements of the Contract Documents, an appropriate Change Order shall be issued by the Owner with the approval of the A-E reflecting an equitable deduction from the Contract Sum on account of the uncorrected Work. The amount of the Change Order shall be deducted from payments then or thereafter due the Contractor. If final payment has already been made, the Contractor shall be responsible for paying the difference to the Owner within a reasonable time, which is generally defined as 30 calendar days from the date of written request for such reimbursement by the Owner.

'21. Suspension of Work

- **'21.1 Suspension by the Owner.** The Owner shall have the right at any time to direct the contractor to suspend its performance, or any portion thereof for a period of not more than thirty (30) calendar days. The notice of suspension shall be in writing and shall set forth the reason for the suspension. The written notice shall fix the approximate date on which Work is contemplated to be resumed. The Owner shall pay the Contractor as full compensation for such suspension the Contractor's Direct Job Expenses.
 - '21.1.1 Should the Contractor believe that the Owner, by its actions, has suspended the Work, but has not received a written notice of suspension from the Owner, the Contractor shall notify the Owner in writing that he believes a suspension of the Work has occurred and seek clarification from the Owner that such suspension of the Work is the Owner's intent by its actions. The Owner will promptly clarify for the Contractor its intensions related to suspension of the Work.
 - **'21.1.2 Without such written notice of suspension of the Work by the Owner,** the Contractor shall proceed with the Work as if it was not suspended and shall not be eligible for compensation as indicated in paragraph '21.1 above.
- **'21.2 Other Suspension.** In the event the Owner should be prevented from proceeding with the work due to a bid protest, or enjoined by court order from proceeding with the Work or from authorizing its prosecution, either before or after the award, for a period up to ninety (90) calendar days, the delay shall not constitute cause for termination by the Contractor and the Contractor shall not be entitled to make or assert claim for damage by reason of said delay, but time for completion of Work shall be extended to such reasonable time as the Owner may determine will compensate for time lost by such delay. Such determination shall be set forth in a Change Order shall be final and binding upon both parties, and shall not require the signature of the Contractor to be in effect.

The Owner shall pay the Contractor as full compensation for such suspension the Contractor's reasonable costs actually incurred and paid as follows:

- '21.2.1 demobilization and remobilization, including such costs paid to subcontractors;
- '21.2.2 preserving and protecting work in place;
- '21.2.3 storage of materials or equipment purchased for the Project, including insurance thereon:
- '21.2.4 performing in a later, or during a longer, time frame than contemplated by this Contract.
- **'21.3 Termination by the Contractor due to Suspension of the Work by the Owner.** If, through no act or fault of the Contractor, the Work is suspended for a period of more than thirty (30) calendar days by the Owner, or more than ninety (90) calendar days under an Order of

the Court or other public authority, then the Contractor may, after ten (10) business days from delivery of a written notice to the Owner and the A-E, terminate the Contract and recover from the Owner payment for all Work executed and reasonable expenses sustained.

'21.3.1 If the A-E has failed to act on a request for payment, within thirty (30) calendar days of submission, or if the Owner has failed to make any payment, within forty-five (45) calendar days of receipt of an approval application for payment, the Contractor may, upon ten (10) business days written notice to the Owner and the A-E stop the Work until he has been paid all amounts then due, in which event and upon resumption of the Work, a Change Order shall be issued adjusting the Contract Price or extending the Contract Time, or both, to compensate for the costs and delays attributable to the stoppage of the work, any such compensation being subject to the provisions, conditions and limitations contained in Article 26.

'22. Termination

- **'22.1 Termination of Contract for Convenience of Owner.** The Owner, for any reason whatsoever, may terminate the Contract for its own convenience when it determines that such termination will be in the best interest of the Commonwealth of Kentucky. The Owner shall give written notice of such termination to the Contractor specifying when termination becomes effective. The Contractor shall incur no further obligations in connection with the Work and the Contractor shall stop Work when such termination becomes effective. The Contractor shall also terminate outstanding orders and subcontracts. The Contractor shall settle the liabilities and claims arising out of the termination of Subcontracts and orders. The Owner may direct the Contractor to assign the Contractor's right, title and interest under termination orders or subcontracts to the Owner or its designee. The Contractor shall transfer title and deliver to the Owner such completed or partially completed Work and materials, equipment, parts, fixtures, information and Contract rights as the Contractor has. The Commonwealth shall negotiate a fair and just settlement with the Contractor in accordance with 200 KAR 5:312 Section 2. In such event, the following procedure shall be required:
 - **'22.1.1** The Contractor shall submit a termination claim to the Owner and the A-E specifying the amounts due because of the termination for convenience together with costs, pricing or other data required by the Owner or the A-E. If the Contractor fails to file a termination claim within one (1) year from the effective date of termination, the Owner shall pay the Contractor, an amount derived in accordance with paragraph (3) below;
 - **'22.1.2** The Owner and the Contractor may agree to the compensation, if any, due to the Contractor hereunder pursuant to 200 KAR 5:312 Section 2;
 - **'22.1.3 Absent agreement to the amount due to the Contractor**, the Owner shall pay the Contractor the following amounts:
 - **'22.1.3.1 Contract prices** for labor, materials, equipment and other services accepted under this Contract:
 - '22.1.3.2 Reasonable costs incurred in preparing to perform and in performing the terminated portion of the Work and in terminating the Contractor's performance, plus a fair and reasonable allowance for direct jobsite overhead and profit thereon (such profit shall not include anticipated profit or consequential damages); provided however, that if it appears that the Contractor would have not profited or would have sustained a loss if the entire Contract would have been completed, no profit shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss, if any;

- **'22.1.3.3 Reasonable costs** of settling and paying claims arising out of the termination of subcontracts or orders pursuant to the initial Paragraph of 22.1. These costs shall not include amounts paid in accordance with other provisions hereof.
- '22.1.3.4 The total sum to be paid the Contractor under 22.1 shall not exceed the total Contract Sum, as properly adjusted, reduced by the amount of payments otherwise made, and shall in no event include duplication of payment.
- **'22.2 Termination of Contract for Cause.** If the Contractor should be adjudged as bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency or, if the Contractor does not perform the Work, or any part thereof, in a timely manner, supply adequate labor, supervisory personnel or proper equipment or materials, or if it fails to timely discharge its obligations for labor, equipment and materials, or proceeds to disobey applicable law, or otherwise commits a violation of a material provision of the resulting Contract, then the Owner, in addition to any other rights it may have against the Contractor or others, may terminate the performance of the Contractor upon ten (10) days written notice by registered mail of declaration of default and assume possession of the Project site and of all materials and equipment at the site and may complete the Work.
 - **'22.2.1** In such case, the Contractor shall not be paid further until the Work is complete. After final completion has been achieved, if any portion of the Contract Sum, as it may be modified hereunder, remains after the cost to the Owner of completing the Work, including all costs and expenses of every nature incurred, has been deducted by the Owner, such remainder shall belong to the Contractor. Otherwise, the Contractor shall pay and make whole the Owner for such cost. This obligation for payment shall survive the termination of the Contract. In the event the employment of the Contractor is terminated by the Owner for cause pursuant to this Paragraph 22.2 and it is subsequently determined by a Court of competent jurisdiction that such termination was without cause, such termination shall thereupon be deemed a Termination for Convenience under Paragraph 22.1 and the provisions of Paragraph 22.1 shall apply.

'23. Indemnification

The Contractor shall indemnify and hold the Owner harmless from any and all claims, liability, damage, loss, cost and expense of every type whatsoever, regardless of whether such liability, claim, damage, loss, cost or expense is caused in part by the Owner, including, without limitation, attorneys' fees and expenses, in connection with the Contractor's performance of this Contract, provided that such claims, liability, damage, loss, cost or expense is due to sickness, personal injury, disease or death, or to loss or destruction of tangible property (other than the Work itself), including loss of use resulting therefrom, to the extent caused by the Contractor, or anyone for whose acts the Contractor may be liable.

'24. Insurance

- **'24.1** The Contractor shall furnish the Owner with certificates evidencing the required insurance coverage prior to commencing work. Contractor shall keep up-to-date copies of such certificates on file with Owner until work is completed. Owner may require Contractor to submit policy endorsements or complete policy copies of the required insurance.
- **'24.2 Contractor shall procure and maintain for the duration of the contract insurance** against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by Contractor, its agents, representatives, employees or subcontractors.
- '24.3 Minimum Scope of Insurance Coverage shall be at least as broad as:

- **24.3.1** Insurance Services Office commercial general liability coverage ("occurrence" Form CG 0001. Ed. 10/93).
- **24.3.2** Insurance Services Office Form CA 0001 (Ed. 12/93) covering automobile liability, Code 1 "any auto."
- **24.3.3** Workers' compensation insurance as required by the Workers' Compensation Act (as contained in KRS Chapter 342) and employers liability insurance.
- '24.4 Minimum Limits of Insurance Contractor shall maintain limits no less than:

24.4.1 Commercial General Liability:

- \$1,000,000 combined single limit per occurrence for bodily injury, personal injury and property damage with a \$3,000,000 annual aggregate. The deducible or Self-Insured Retention per occurrence shall not be more than \$10,000.
- **24.4.2** Automobile Liability: \$500,000 combined single limit per accident for bodily injury and property damage.
- **24.4.3** Workers' Compensation and Employers Liability: Workers' compensation with statutory benefits without limit, as required by the Kentucky Workers Compensation Act, and employer's liability limits of \$1,000,000 per accident.
- **'24.5 Other Insurance Provisions** The policies are to contain, or be endorsed to contain, the following provisions:
 - '24.5.1 Commercial General Liability and Automobile Liability Coverages.
 - **'24.5.1.1 Owner, its officers and employees are to be covered as insureds as respects:** liability arising out of activities performed by or on behalf of the Contractor; general supervision of the work by Owner; products and completed operations of the Contractor; premises owned, occupied or used by the Contractor, or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to Owner, its officers or employees.
 - '24.5.1.2 The Contractor's insurance coverage shall be primary insurance as respects Owner, its officers and employees. Any insurance of self-insurance maintained by Owner shall be excess of the Contractor's insurance and shall not contribute to it.
 - **'24.5.1.3** Any failure to comply with reporting provisions of the policies shall not affect coverage provided to Owner, its officers or employees.
 - **'24.5.1.4** The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought except with respect to the limits of the insurer's liability.
 - '24.5.2 All Coverages. Each insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, canceled by either party, reduced in coverage or in limits except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given to Owner.
- **'24.6 Acceptability of Insurers** Insurance is to be placed with insurers with an A.M. Best's rating of no less than A VII, authorized to write insurance in the Commonwealth of Kentucky.
- **'24.7 Verification of Coverage** The Contractor shall furnish the Owner with certificates evidencing the required insurance coverage prior to commencing work. Contractor shall keep up-to-date copies of such certificates on file with Owner until work is completed. Owner may

require Contractor to submit policy endorsements or complete policy copies of the required insurance.

- **'24.8 Subcontractors** Contractor shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to all of the requirements stated herein.
- **'24.9** The Contractor shall provide all Risks Insurance in an amount of not less than one hundred percent (100%) of the insurable value of all the work. The coverage, is to be written on CP 00 20 06 95 or equivalent acceptable to the Commonwealth. All coinsurance clauses in the Risks Insurance policy will be waived. All rights of subrogation against the Owner (i.e. the Commonwealth) will be waived by the insurer. Such insurance shall be for the benefit of the Contractor, Owner and any Subcontractor engaged on this project, as the Owner shall find their respective interest may appear. The Risks Insurance must be dated and in force on the date indicated in the Contract to begin work.
- '24.10 The insurance coverage required by the contract documents shall be in compliance with the laws of the Commonwealth of Kentucky and shall be placed with a licensed resident or non-resident agent who represents insurance companies authorized to do business in Kentucky.
- **'24.11** The Certificate of Insurance or Certificates of Insurance will have the following endorsements as an attachment to the Certificate or Certificate's.
 - **'24.11.2** The Commonwealth of Kentucky, Division of Engineering and Contract Administration will be named as an additional insured.
 - **'24.11.3** The policy is primary coverage and any insurance or self-insurance maintained by the Commonwealth of Kentucky shall be excess.
 - **'24.11.4** Any failure of the named insured to comply with the reporting provisions of the policy shall not affect coverage provided to the Commonwealth of Kentucky, it's officers or employees.
 - **'24.11.5** All Coverages. Each insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, cancelled by either party, reduced in coverage or in limits except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given to Owner.

'25. Performance and Payment Bonds

The Contractor shall furnish separate performance and payment bonds to the Owner. The Contractor shall furnish a performance bond satisfactory to the Owner in an amount equal to one hundred percent (100%) of the Contract Sum as security for the faithful performance of the Contract. The Contractor shall also furnish a payment bond satisfactory to the Owner in an amount equal to one hundred percent (100%) of the Contract Sum for the protection of all persons performing labor or furnishing materials, equipment or supplies for the Contractor or his Subcontractor for the performance of the Work provided for in the Contract, including security for payment of all unemployment contributions which become due and payable under Kentucky Unemployment Insurance Law.

'25.1 Each bond furnished by the Contractor shall incorporate by reference the terms of the Contract as fully as though they were set forth verbatim in such bonds. In the event the Contract Sum is adjusted by Change Order executed by the Contractor, the penal sum of both the performance bond and the payment bond shall be deemed increased by like amount.

'25.2 The performance and payment bonds shall be executed by a surety company authorized to do business in this Commonwealth, and the contract instrument of bonds must be countersigned by a duly appointed and licensed resident agent.

'26. Claims by the Contractor/ Concealed Conditions/ Disputes

- **'26.1** Claims by the Contractor against the Owner are subject to the following:
 - '26.1.1 All Contractor claims against the Owner shall be initiated by a written claim submitted to the Owner and the A-E. Such claim shall be filed with the Owner and the A-E no later than seven (7) calendar days after the event, or the first appearance of the circumstances, causing the claim, and same shall set forth in detail all known facts and circumstances supporting the claim;
 - **'26.1.2** The **Contractor and the Owner shall continue their performance** regardless of the existence of any claims submitted by the Contractor.
 - '26.1.3 In the event the Contractor discovers previously concealed and unknown site conditions which differ materially from those indicated in the Contract Documents, or unknown site conditions which are materially at variance from those typically and ordinarily encountered in the general geographical location of the Project, the Contract Sum shall be modified, either upward or downward, upon the written claim made by either party within seven (7) calendar days after the first appearance to such party of the circumstances.
 - '26.1.3.1 As a condition precedent to the Owner having any liability to the Contractor due to concealed and unknown conditions, the Contractor must give the Owner and the A-E written notice of, and an opportunity to observe, such condition prior to disturbing it.
 - '26.1.3.2 The failure by the Contractor to give the written notice and make the claim as provided by this paragraph shall constitute a waiver by the Contractor of any rights arising out of or relating to such concealed and unknown condition;
 - **'26.1.4** In the event the Contractor seeks to make a claim for an increase in the Contract Sum, as a condition precedent to any liability of the Owner therefor, the Contractor shall strictly comply with the requirements of the first paragraph of this Article and such claim shall be made by the Contractor before proceeding to execute any additional or changed Work. Failure of the condition precedent to occur shall constitute a waiver by the Contractor of any claim for additional compensation;
 - '26.1.5 In connection with any claim by the Contractor against the Owner for compensation in excess of the Contract Sum, any liability of the Owner for the Contractor's cost shall be strictly limited to direct cost incurred by the Contractor and shall in no event include indirect cost or consequential damages of the Contractor. The Contractor shall provide a detailed breakdown of the direct cost incurred by the Contractor. The inclusion of the Contractor's 15% OHP to this direct cost shall constitute the Owner's reimbursement to the Contractor for all indirect cost and consequential damages.
 - **'26.1.6** The Owner shall not be liable to the Contractor for claims of third-parties including subcontractors, unless and until liability of the Contractor has been established therefor in a court of competent jurisdiction;
- '26.2 In the event the Contractor should be delayed in performing any task which at the time of the delay is then critical, or which during the delay becomes critical, as the sole result of any act or omission by the Owner or someone acting in the Owner's behalf, or by Owner-authorized Change Orders, unusually bad weather not reasonably anticipatable, fire or other

Acts of God, the date for achieving Substantial Completion, or, as applicable, final completion, shall be appropriately adjusted by the Owner upon the written claim of the Contractor to the Owner and the A-E.

- '26.2.1 An extension of time shall not mean that the Contractor is entitled to additional compensation.
- '26.2.2 A task is critical within the meaning of this paragraph if, and only if, said task is on the critical path of the Project schedule so that a delay in performing such task will delay the ultimate completion of the Project.
- '26.2.3 Any claim for an extension of time by the Contractor shall strictly comply with the requirements of the first paragraph of this Article above. If the Contractor fails to make such claim as required in this paragraph, any claim for an extension of time shall be waived.
- **'26.3** All claims under this Contract shall be made in accordance with KRS 45A.225 to 45A.290. The provisions of these statutes do not toll the running of the Statute of Limitations set forth in KRS 45A.260. Any suit pursuant to KRS 45A.245 shall be commenced within one (1) year of the Substantial Completion Date specified in the Contract. If the Contractor does not commence suit within one (1) year of the date specified in the Contract, the Contractor shall be foreclosed from proceeding in court pursuant to KRS 45A.245.
 - '26.3.1 The Owner and Contractor agree that any suit, action or proceeding with respect to this Contract may only be brought in or entered by the courts of the Commonwealth of Kentucky situated in Frankfort, Franklin County, Kentucky, or the United States District Court for the Eastern District of Kentucky, Frankfort Division, and the parties hereby submit to the non-exclusive jurisdiction of such courts for the purpose of any such suit, action, proceeding or judgment and waive any other preferential jurisdiction by reason of domicile or location. The parties hereby agree that any such legal action shall be tried by the court sitting without a jury. The parties hereby irrevocably waive any objection that they may now or hereafter have to the laying of venue of any suit, action or proceeding arising out of or related to this Contract brought in the courts of the Commonwealth of Kentucky situated in Frankfort, Franklin County, Kentucky, or the United States District Court for the Eastern District of Kentucky, Frankfort Division, and also hereby irrevocably waive any claim that any such suit, action or proceeding brought in any one of the above-described courts has been brought in an inconvenient forum.

'27 Liens

The filing and perfection of liens for labor, materials, supplies and rental equipment supplied on the work are governed by KRS 376.195 to 376.260.

- **'27.1** The lien shall attach only to any unpaid balance or retainage due the Contractor for the improvement from the time a copy of statement of lien, attested by the County Clerk, is delivered to the Owner, pursuant to the provisions of KRS 376.240
- '27.2 Statements of lien shall be filed with the Franklin County Clerk and action to enforce the same must be instituted in the Franklin Circuit Court, Frankfort, Kentucky, pursuant to KRS 376.250(2).

'28 Assignments

Neither party to the Contract shall assign the Contract, or any portion thereof without the written consent of the other, nor shall the Contractor assign any monies due or to become due to him hereunder without notification to the Owner. Notification of Assignments, shall be given on State

forms and in accordance with the procedures and regulations of the Finance and Administration Cabinet.

'29 Separate Contracts

- **'29.1 Owner's Right to Perform Construction and to Award Separate Contracts.** The Owner reserves the right to let other contracts in connection with the Project or to perform Work with its own forces. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work and shall properly connect and coordinate his Work with theirs.
 - **'29.1.1 If any part of the Contractor's Work depends** for proper execution or results upon the Work of any other contractor, the Contractor shall promptly report to the A-E any observed defects in such Work that render it unsuitable for proper execution or connection. His failure to inspect and report shall constitute an acceptance of the other contractor's Work as fit and proper for the reception of his Work, except as to defects which may develop in the other contractor's Work after the execution of his Work.
 - '29.1.2 If any part of another contractor's work depends on the Contractor's Work for proper execution, the Contractor shall promptly perform that Work as required to allow the other contractor's work to progress as originally intended by the Owner's separate contract with that contractor.
 - '29.1.3 Whenever Work being done by the Owner's forces or by other Contractors work under separate agreement with the Owner is contiguous to Work covered by this Contract, the respective rights of the various interests involved shall be established by the A-E to secure the completion of the various portions of the Work in general harmony.
- **'29.2 Mutual Responsibility of Contractors.** Should the Contractor cause damage to any separate contractor on the Work, the Contractor agrees, upon due notice, to settle with such contractor if he will so settle. If such separate contractor sues the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall defend such proceedings at the Contractor's expense and if any judgment against the Owner arises therefrom, the Contractor shall pay or satisfy it and pay all costs incurred by the Owner.

'30 Allowances

- '30.1 The Contractor shall have included in the Contract Sum all allowances stated in the Contract Documents and shall cause the Work so designated to be done as the Owner may direct. If the actual price for purchasing the "allowed material" is more or less than the "cash allowance," the Contract Sum shall be adjusted accordingly.
- **'30.2 The adjustment in Contract Sum shall be made on the basis** of the purchase price without additional charges for overhead, profit, insurance or any other incidental expenses. The cost of installation of the "allowed materials" shall be included in the applicable sections of the Contract specifications covering this Work. (see Article 14, paragraph 14.2 for more information).

'31 Project Meetings

- **'31.1 Pre-Construction Conference:** No later than 10 calendar days after execution of the Contract a Pre-Construction Conference will be held at the Project Site or another convenient location. This meeting will be scheduled by the Owner through the A-E.
- '31.1.1 Attendance at the Pre-Construction conference is mandatory for the following personnel: Authorized Representatives of the Owner; A-E and their

- consultants; Contractor and his Project Manager, Job Superintendent and key personnel; all major subcontractors; Using Agency on-site personnel; and other persons designated by the A-E, Owner, or Contractor to be critical to the project.
- '31.1.2 All participants shall be familiar with the Project and authorized to conclude matters relating to the Work.
- '31.1.3 Agenda for the meeting will include all matters indicated in the DECA Capital Construction Procedures Manual related to the project. The meeting will be conducted by the A-E and minutes distributed within three working days following the meeting.
- **'31.2 Pre-Installation Conferences**: Pre-installation Conferences shall be held at the Project Site or another convenient location for any item of the work requiring a pre-installation conference. The conference is required PRIOR to each construction activity that requires coordination with other construction.
- '31.2.1 Attendance at the Pre-Installation Conference is mandatory for the following personnel: Authorized Representatives of the Owner; A-E and their consultants who have responsibilities related to the installation; Contractor and his Project Manager, Job Superintendent and key personnel; all subcontractors with work related to the installation; Installers of the work; Manufacturer's and Fabricator's Representatives related to the installation; and other persons designated by the A-E, Owner, or Contractor to be critical to the project.
- '31.2.2 All participants shall be familiar with the up-coming installation and authorized to conclude matters relating to the Work.
- '31.2.3 Agenda for the meeting will include all matters indicated in the DECA Capital Construction Procedures Manual related to the project. The meeting will be conducted by the Contractor and minutes distributed within three working days following the meeting.
- **'31.3 Project Progress Meetings:** At regular intervals during the construction (a minimum of monthly, but may be more frequently at the discretion of the A-E/ Owner, Project Progress Meetings will be held at the Project Site or another convenient location. This meeting will be scheduled at the Pre-Construction Conference or when more frequently needed by the Owner through the A-E.
- '31.3.1 Attendance at the Project Progress Meeting is mandatory for the following personnel: Authorized Representatives of the Owner; A-E and their consultants; Contractor and his Project Manager, Job Superintendent and key personnel; all major subcontractors who have work completing, continuing or commencing; Using Agency onsite personnel; and other persons designated by the A-E, Owner, or Contractor to be critical to the project.
- '31.3.2 All participants shall be familiar with the Project and authorized to conclude matters relating to the Work.
- '31.3.3 Agenda for the meeting will include all matters indicated in the DECA Capital Construction Procedures Manual related to the project. The meeting will be conducted by the A-E and minutes distributed within three working days following the meeting.

'31.3.4 Elsewhere in these General Conditions are submittals and other requirements of the Contractor that are to be provided at each Project Progress Meeting (i.e. updated Project Schedule, updated submittal log; updated RFI log, etc.

'32. Miscellaneous Provisions Regarding Contractor's Work

- **'32.1 Project Site Limits.** The Contractor shall confine his apparatus, the storage of materials, and the operations of his workmen to Project site limits indicated by the Contract Documents.
- **'32.2 Points of Reference.** The Contractor shall carefully preserve bench marks, reference points and stakes, and in case of willful or careless destruction, he shall be charged with the resulting expense of replacement and shall be responsible for any mistake that may be caused by their unnecessary loss or disturbance.
- '32.3 Cutting and Patching. The Contractor shall be responsible for cutting, fitting or patching required to complete the Project or make its parts fit together in a proper manner. The Contractor shall not endanger other parts of the Project, including work by the Owner or other contractors as provided in Article 29, by cutting, patching, or excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a separate contractor without written consent of the Owner or such separate contractor. Such consent shall not be unreasonably withheld.
- **'32.4 Cleanup.** The Contractor shall at all times keep the Project premises and surrounding area free from the accumulation of waste materials or rubbish caused by his operations in connection with the Project. Upon completion of the Work, and prior to final inspection and acceptance, the Contractor shall remove all remaining waste materials, rubbish, Contractor's construction equipment, tools, machinery, and surplus materials and leave the Project (including but not limited to glass, hardware, fixtures, masonry, tile and marble) in a clean and usable condition satisfactory to the A-E. Floors shall be cleaned and waxed in accordance with the requirements of the Contract specifications. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may perform the cleaning tasks and charge the cost to the Contractor by Change Order.

'32.5 Guarantees, Warranties and "As-Built" Drawings.

- **'32.5.1** Prior to final payment for the Work, the Contractor shall assemble and present to the A-E all guarantees and warranties required by the Contract Documents.
- **'32.5.2** All warranties for materials, equipment and installations constructed by this project shall commence on the Date of Substantial Completion and continue for the period of time indicated for the specific material, equipment or installation.
- '32.5.3 Additionally the Contractor shall provide "Record" Drawings prior to final payment.
- **'32.6 Governing Law.** The Contract shall be governed by the laws of the Commonwealth of Kentucky.
 - '32.6.1 Statutory Limitation Periods. Statutes of Limitations are governed by KRS 45A.260(2).
 - **'32.6.2 Written Notice.** Written notice shall be deemed to have been given if delivered in person to the individual or to a member of the organization or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last known business address known to the notifying party.

'33. Apprentices

Apprentices (for all classifications of work) shall be permitted to work only under an apprenticeship agreement approved by the Kentucky Supervisor of Apprenticeship and by the Kentucky Apprenticeship Council which is recognized by the Bureau of Apprenticeship and Training, U. S. Department of Labor.

'34. Nondiscrimination in Employment

During the performance of the Contract, the Contractor agrees as follows:

- '34.1 The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or disability in employment.
- '34.2 The Contractor will take affirmative action in regard to employment, upgrading, demotion, transfer, recruitment, recruitment advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training, so as to ensure that applicants are employed and that employees during employment are treated without regard to their race, color, religion, sex, age, or national origin; however, when layoffs occur, employees shall be laid off according to seniority with the youngest employees being laid off first. When employees are recalled, this shall be done in the reverse way the employees were laid off;
- '34.3 The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age, or national origin;
- '34.4 The Contractor will post notices in conspicuous places, available to employees and applicants for employment, setting forth the provisions of the nondiscrimination clauses required by this section;
- '34.5 The Contractor shall send to each labor union or representatives of workers with which he has a collective bargaining agreement or other contract or understanding, a notice advising the labor union or workers' representatives of the Contractor's commitments under this section.

Failure to comply with the above nondiscrimination clause constitutes material breach of Contract.

'35 Affirmative Action; Reporting Requirements

- '35.1 The Contractor and Subcontractors are exempt from any affirmative action or reporting requirements, under the Kentucky Equal Employment Act of 1978, KRS 45.560 to 45.640 hereinafter referred to as The Act, if any of the following conditions are applicable:
 - (1) the Contract or subcontract awarded is in the amount of five hundred thousand dollars (\$500,000) or less, and the amount of the contract is not a subterfuge to avoid compliance with the provisions of The Act; or
 - (2) the Contractor or Subcontractor utilizes the services of fewer than eight (8) employees during the course of the Contract; or
 - (3) the Contractor or subcontractor employs only family members or relatives; or

- (4) the Contractor or Subcontractor employs only persons having a direct Ownership interest in the business and such interest in not a subterfuge to avoid compliance with the provisions of The Act.
- **'35.2 The Contractor or Subcontractor not otherwise exempted** shall for the duration of the Contract, hire minorities from within the drawing area to satisfy the agreed upon goals and timetables set out in addenda to the Contract. Should the union with which the Contractor has collective bargaining agreements be unwilling to provide sufficient minorities to satisfy the goals and timetables, the Contractor shall hire minorities from other sources within the drawing area to satisfy the goals and timetables in the addenda to the Contract.
- **'35.3** The equal employment provisions of The Act may be met in part by the Contractor subcontracting to a minority contractor or subcontractor. A minority contractor or subcontractor shall be defined by the addenda to this Contract, or if none, by the Act.
- **'35.4** Each Contractor shall, for the length of the Contract, furnish such information as required by The Act and by such rules, regulations and orders issued pursuant thereto and will permit access to all books and records pertaining to his employment practices and work sites by the contracting agency and the department for purposes of investigation to ascertain compliance with The Act and such rules, regulations and orders issued pursuant thereto.
- '35.5 If the Contractor is found to have committed an unlawful practice against a provision of The Act during the course of performing under this Contract, (if covered by The Act), the Owner may cancel or terminate the Contract, conditioned upon a program for future compliance approved by the Owner. The Owner may also declare such Contractor ineligible to bid on further contracts until such time as the Contractor complies in full with the requirements of The Act.
- '35.6 The Contractor shall not be required to terminate an existing employee, upon proof that employee was employed prior to the date of the Contract nor hire anyone who fails to demonstrate the minimum skills required to perform a particular job.

'36 Access to Records

- **'36.1** The contractor, as defined in KRS 45A.030(7), agrees that the contracting agency, the Finance and Administration Cabinet, the Auditor of Public Accounts, and the Legislative Research Commission, or their duly authorized representatives, shall have access to any books, documents, papers, records, or other evidence, which are directly pertinent to this contract for the purpose of financial audit or program review.
- '36.2 Furthermore, any books, documents, papers, records, or other evidence provided to the contracting agency, the Finance and Administration Cabinet, the Auditor of Public Accounts, or the Legislative Research Commission which are directly pertinent to the contract shall be subject to public disclosure regardless of the proprietary nature of the information, unless specific information is identified and exempted and agreed to by the Secretary of the Finance and Administration Cabinet as meeting the provisions of KRS 61.878(1)(c) prior to the execution of the contract.
- '36.3 The Secretary of the Finance and Administration Cabinet shall not restrict the public release of any information which would otherwise be subject to public release if a state government agency was providing the service. (22 Ky.R. 1510; eff. 5-16-96.)

'37 Commonwealth Project Forms and other weblinks:

- '37.1 The Commonwealth of Kentucky does not recognize any project forms from third party sources (i.e. American Institute of A-Es; Association of Construction and Development; Association of General Contractors; etc.) unless the Commonwealth has not adopted specific documents.
 - '37.1.1 When the Commonwealth has not adopted specific documents for a construction document purpose, other documents may be used provided that they do not conflict with these General Conditions and other documents and contracts of the Commonwealth in any respect.
 - '37.1.2 Any conflict between a construction document utilized and any provision of these General Conditions or other documents and Contracts of the Commonwealth, shall be immediately considered null and void.
- '37.2 The weblink to the State Planroom site where Commonwealth Construction forms, contracts, and manuals are located is:

https://finance.ky.gov/services/stateplan/Pages/ConstructionFormsandInformation.aspx

37.2.1 A listing of documents available on this site includes the following:

Required Affidavits and Statements

- Affidavit for Final Payment (B-210-13)
- Affidavit for Bidder, Offerors and Contractors
- Vendor Report of Prior Violations

Invoices and Change Order Form

- DOA-24 Invoice *For contracts greater than \$400,000 (05-06-08)
- SAS-25 Invoice Short Form *For contracts less than \$400,000 (09-29-11)
- SAS-25 A-Eing Consultants Form (11-19-10)
- SAS-42 Change Order Form (09-27-06)

Example Invoice Forms

- DOA-24 Continuation Sheet (Example)
- DOA-24 Long Form (Example) (09-27-06)
- SAS-25 Short Form (Example) (09-29-11)

EEO Forms

- Affidavit of Intent to Comply
- EEO-1: Employer Information Report
- Subcontractor Reporting Part

Manuals

- Capital Construction Project Procedures Manual (Updated 6-22-13)
- Technical Guidelines and Specifications Complete Version (12-15-13)
- Capital Construction Project Procedures manual (Full collection)

'37.3 The weblink to the State's Document Collaboration System is:

https://www.stateofkyprojects.com/

'37.3.1 This Document Collaboration System shall be used for all official and/or required communication and documentation of any Capital Construction Project where these General Conditions apply.

END OF GENERAL CONDITIONS

Payment Bond - Part IV

| CONTRACTOR (Name and Address): | SURETY (Name and Princi | SURETY (Name and Principal Place of Business): | |
|---|---------------------------|--|--|
| | | | |
| OWNER (Name and Address): | | | |
| Commonwealth of Kentucky | | | |
| Finance and Administration Cabinet | | | |
| Bush Building 1 st Floor | | | |
| 403 Wapping Street | | | |
| Frankfort, KY 40601-2638 | | | |
| CONSTRUCTION CONTRACT | | | |
| DATE:AMOUNT: | | | |
| | | | |
| DESCRIPTION (Name and Location) | | | |
| Invitation No: | | | |
| BOND | • | | |
| DATE: | | | |
| AMOUNT: | | | |
| CONTED A CITION A CIPRINICIPAL | SURETY | (0 (0 1) | |
| CONTRACTOR AS PRINCIPAL Company: (Corporate Seal) | Company: | (Corporate Seal) | |
| Company. (Corporate Sear) | | | |
| | Signature: | | |
| Signature: | Name and Title: | | |
| Name and Title: | 7 / 1 | | |
| | Name, Address and Telepho | ne of AGENT or BROKER: | |
| Name, Address and Telephone of AGENT or BROKER: | | | |

Whereas, the Owner has required the Contractor to furnish this Payment Bond containing the terms and conditions set forth herein as a condition to executing the Construction Contract with the Contractor;

Now therefore, the Surety and the Contractor, both severally, and for themselves, their heirs, administrators, executors and successors agree:

- 1. The Construction Contract is hereby incorporated herein and by reference made a part hereof to the same extent and effect as though it were copied verbatim herein. The Surety and the Contractor are bound for the full performance of the Construction Contract including without exception all of its terms and conditions, both express and implied, and, without limitation, specifically including Contractor's obligation to pay for labor, materials, services and equipment provided in connection with the Construction Contract performance.
- 2. For purposes of this Payment Bond, Beneficiary is defined as person or entity who has actually provided labor, material, equipment, services or other items for use in furtherance of the Construction Contract, and having:
 - (A) a direct contract with the Contractor; or
 - (B) a direct contract with a subcontractor of the Contractor; or
 - (C) rights, under the laws of the jurisdiction where the Project is located, to file a lien, a claim or notice of lien, or otherwise make a claim against the Project or against funds held by the Owner, if the Project is, or were, subject to such filing.
- 3. The Surety shall not be obligated hereunder to a Beneficiary other than a Beneficiary having a direct contract with the Contractor unless such Beneficiary has given written notice of its claim to the Contractor and the Surety as follows:

- (A) the period of time provided by the jurisdiction wherein the Project is located for (1) filing a lien, claim of lien, notice of lien, if the Project is, or were, subject to such filing (KRS 376.230), or (2) otherwise making a claim against the Project or against funds held by the Owner:
- (B) address, the person or entity to whom such labor, material, equipment, services or other items were provided.
- 4. In no event shall the Surety be obligated hereunder for sums in excess of the Penal Sum as it may be modified by addendum.
- 5. Upon receipt of claim from a Beneficiary hereunder, the Surety shall promptly, and in no event later than 30 days after receipt of such claim, respond to such claim in writing (furnishing a copy of such response to the owner) by:
 - (A) making payment of all sums not in dispute; and
 - (B) stating the basis for disputing any sums not paid.
- 6. No action shall be commenced by a Beneficiary hereunder after the passage of the longer of two (2) years following the date on which the final payment of the contract falls due or, if this bond is provided in compliance with applicable law, any limitation period provided therein. If the limitation period contained in this Paragraph is unenforceable, it shall be deemed amended to provide the minimum period for an action against the Surety on a payment bond by a third-party beneficiary thereof.
- 7. Any and all notices to the Surety or the Contractor shall be given by Certified Mail, Return Receipt Requested, to the address set forth for each party above.

Commonwealth of Kentucky Finance and Administration Cabinet Department for Facilities and Support Services Division of Engineering and Contract Administration

Performance Bond - Part V

| CONTRACTOR (Name and Address): | SURETY (Name and Principal Place of Business): |
|---|---|
| OWNER (Name and Address): Commonwealth of Kentucky Finance and Administration Cabinet Bush Building 1 st Floor 403 Wapping Street Frankfort, KY 40601-2638 | |
| CONSTRUCTION CONTRACT - «ContractNumber» | |
| DATE: AMOUNT: | |
| DESCRIPTION (Name and Location) | |
| BOND | |
| DATE: | |
| AMOUNT: | |
| CONTRACTOR AS PRINCIPAL | |
| Company: (Corporate Seal) | |
| | SURETY |
| Signature: | Company: (Corporate Seal) |
| Name and Title: | (corporate ecal) |
| Name, Address and Telephone of AGENT or BROKER: | Signature: Name and Title: |
| | Name, Address and Telephone of AGENT or BROKER: |

Whereas, the Owner has required the Contractor to furnish this Performance Bond containing the terms and conditions set forth herein as a condition to executing the Construction Contract with the Contractor;

Now therefore, the Surety and the Contractor, both severally, and for themselves, their heirs, administrators, executors and successors agree:

- 1. The Construction Contract is hereby incorporated herein and by reference made a part hereof to the same extent and effect as though it were copied verbatim herein. The Surety and the Contractor are bound for the full performance of the Construction Contract including without exception all of its terms and conditions, both express and implied.
- 2. If the Contractor is in default of the Construction Contract and the Owner, by written notice to the Contractor and the

Surety, declares the Contractor to be in default and terminates the right of the Contractor to proceed, the Surety shall thereupon promptly notify the Owner in writing as to which of the actions permitted to the Surety in Paragraph 3 it will take.

- 3. Upon the default and termination of the Contractor and notice to the Contractor and Surety as provided in Paragraph 2 above, the Surety shall within 30 days proceed to take one or, at its option, more than one of the following courses of action:
- (A) Proceed itself, or through others acting on its behalf, to complete full performance of the Construction Contract including, without limitation, correction of defective and nonconforming work performed by or on behalf of the Contractor. During such performance by the Surety the Owner shall pay the Surety from its own funds only such sums as would have been due and payable to

the Contractor in the absence of the default and termination.

- (B) Applicable law permitting, and with the prior written consent of the Owner, obtain bids or proposals from contractors previously identified as being acceptable to the Owner, for full performance of the Construction Contract. The Surety shall furnish the Owner a copy of such bids or proposals upon receipt of same. The Surety shall promptly select, with the agreement of the Owner, the best responsive bid or proposal and shall promptly tender the contractor submitting it, together with a contract for fulfillment and completion of the Construction Contract executed by the completing contractor, to the Owner for the Owner's execution. Upon execution by the Owner of the contract for fulfillment and completion of the Construction Contract, the completing contractor shall furnish to the Owner a Performance Bond and a separate payment bond, each in the form of those bonds previously furnished to the Owner for the project by the Contractor. Each such bond shall be in the penal sum of the (1) fixed price for completion. (2) guaranteed maximum price for completions, or (3) estimated price for completion, whichever is applicable. The Owner shall pay the completing contractor from its own funds only such sums as would have been due and payable to the Contractor under the Construction Contract as and when they would have been due and payable to the Contractor in the absence of the default and termination. To the extent that the Owner is obligated to pay the completing contractor sums which would not have then been due and payable to the Contractor under the Construction Contract, the Surety shall provide the Owner with such sums in a sufficiently timely manner that the Owner can utilize such sums in making timely payment to the completing contractor; or.
- (C) Take any and all other acts if any, mutually agreed upon in writing by the Owner and the Surety.
- 4. In addition to those duties set forth hereinabove, the Surety shall promptly pay the Owner all loss, costs and expenses resulting from the Contractor's default(s), including, without limitation, fees, expenses and costs for

- architects, engineers, consultants, testing, surveying and attorneys, liquidated or actual damages, as applicable, for delay in completion of the Project, and fees, expenses and costs incurred at the direction, request, or as a result of the acts or omissions of the Surety.
- 5. In no event shall the Surety be obligated to the Owner hereunder for any sum in excess of the Penal Sum as it may be modified by addendum.
- 6. The Surety waives notice of any changes to the Construction Contract including, without limitation, changes in the contract time, the contract price, or the work to be performed.
- 7. This Performance Bond is provided by the Surety for the sole and exclusive benefit of the Owner, and, if applicable, any dual obligee designated by rider attached hereto, together with their heirs, administrators, executors, successors or assigns. No other party, person or entity shall have any rights against the Surety hereunder.
- 8. No action shall be commenced hereunder after the passage of the longer of two (2) years following the date on which the final payment of the contract falls due or, if this bond is provided in compliance with applicable law, any limitation period provided therein. If the limitation period contained in the Paragraph is unenforceable, it shall be deemed amended to provide the minimum period for an action against the Surety on a performance bond.
- 9. Any and all notices to the Surety, the Contractor or the Owner shall be given by Certified Mail, Return Receipt Requested, to the address set forth for each party above.
- 10. Any statutory limitation, which may be contractually superseded, to the contrary notwithstanding, any action hereon may be instituted so long as the applicable statute of limitations governing the Construction Contract has not run or expired.

PART VI

FINANCE AND ADMINISTRATION CABINET DEPARTMENT FOR FACILITIES AND SUPPORT SERVICES DIVIION OF ENGINEERING AND CONTRACT ADMINISTRATION

AGREEMENT BETWEEN OWNER AND CONTRACTOR

| This AGREEMENT, between the Owner, the COMMONWEALTH OF KENTUCKY, and the Contractor |
|---|
| The Architect is: |
| This Agreement, properly by the parties, shall be final and binding only upon the issuance of the Finance and Administration Cabinet Construction Contract. |
| The Owner and Contractor agree as set forth below. |
| Article No. 1 THE CONTRACT DOCUMENTS: |
| The Contract Documents consist of the Agreement, the Official Bid Documentl, the Invitation to Bids, the Instructions to Bidders, the General Conditions, Supplement Conditions, Drawings, Specifications, and Addenda issued prior to the execution of this Agreement, and modifications made after the execution of this Agreement. The Contract Documents represent the entire and integrated agreement between the parties. All of these documents are as fully a part of this Agreement as if attached to this Agreement or repeated herein. |
| Article No. 2 SCOPE OF WORK: |
| The Contractor shall execute the entire work described in the Contract Documents entitled: INVITATION TO BID NO SOLICITATION NO |
| |
| |
| |

A listing of the Specifications, Drawings and Addenda are contained in Article 11 of this

Agreement

.Article No. 3 TIME OF COMPLETION:

| The date of commencement for the work shall be the date upon which the Owner issues the Contract Documents. The Contractor shall achieve substantial completion of the entire work (as defined by Article 19.4 of the General Conditions) not later than calendar days/date after the date of commencement for the work, subject to adjustments of contract time as provided in the Contract Documents. Final completion of the work shall be achieved calendar days/date after the scheduled date of substantial completion. |
|--|
| Article No. 4 LIQUIDATED DAMAGES: |
| It is understood by the parties that time is of the essence of this contract, and that the Owner will sustain substantial financial damages and other injuries in the event of a failure of the Contractor to complete the work in a timely manner. In light of these foreseeable losses, and the difficulty of proof of loss, the Contractor shall be assessed liquidated damages in the amount of for each calendar day between the date set for substantial completion of this work and the actual date upon which substantial completion is achieved in accordance with Article 19.4 of the General Conditions. The Contractor shall be assessed liquidated damages in the amount of for each calendar day between the date set for final completion of this work and the actual date upon which final completion is achieved in accordance with Article 19.5 of the General Conditions. In the event that the Contractor abandons the work prior to the substantial completion or is terminated for default under Article 22.2 of the General Conditions, the Owner may upon completion of the work recover either (1) liquidated damages for the entire period of delay to substantial completion or final completion under this Article, or (2) actual delay-related damages. This recovery will be in addition to any other rights and remedies the Owner may have against the Contractor. |
| Article No. 5 CONTRACT SUM: |
| The Owner shall pay the Contractor for the Contractor's performance of the contract the sum of, (), subject to additions and deductions as provided in the Contract Documents. The Contract Sum is based upon the alternates, if any, which are described in the Contract Documents and are hereby |
| accepted by the Owner. |

Article No. 6 PROGRESS PAYMENTS:

Based upon applications for payment submitted to the Architect by the Contractor, the Owner shall make progress payments on the account of the Contract Sum to the Contractor in accordance with Article 18 of the General Conditions.

Article No. 7 ACCEPTANCE AND FINAL PAYMENT:

Final payment shall be due in accordance with Article 18.7 of the General Conditions provided, that all work has been fully completed in accordance with the plans and specifications as evidenced by a certificate by the Architect for the project, and it has been accepted by the Owner. Further, final payment is contingent upon receipt of "As-Built" drawings from the Contractor. The Contractor shall submit with his final payment application evidence satisfactory to the Architect that all payrolls, material bills and other indebtedness connected with the work have been paid or that provisions for the satisfaction thereof have been made.

Article No. 8 CHANGES IN THE WORK:

The Owner, without invalidated the contract, may delete, add to or modify the work in accordance with Article 14 of the General Conditions.

Article No. 9 SPECIAL NOTICE REGARDING PAYROLL TAXES, ETC:

The Contractor hereby certifies that he has fully informed himself of the conditions relating to construction and labor under which the work under this contract is to be performed, and accepts liability for payment of all payroll taxes on deductions required by local, state, and federal law, including but not limited to old age pension, social security, or annuities, and agrees that he shall employ, so far as is predictable, methods and means in carrying out his work as will not interfere with or interrupt the work of any other contractor working on or adjacent to the site for this work.

Article 10 TERMINATION OR SUSPENSION:

The contract may be terminated by the Owner upon the default of the Contractor and terminated for convenience of the Owner as provided for in Article 22 of the General Conditions.

Article No. 11 ENUMERATION OF SPECIFICATIONS, DRAWINGS AND ADDENDA:

The Contract Documents, except for Modifications issued after the execution of this Agreement, include the following specifications, drawings and addenda:

SPECIFICATIONS:

| DOCUMENT | TITLE | PAGES |
|---|-------|---------------|
| | | |
| DRAWINGS: | | |
| SHEET NUMBERS | | |
| | | |
| | | |
| | | |
| | | |
| ADDENDA: | | |
| NUMBERS | | |
| | | $\overline{}$ |
| | | \wedge |
| | | |
| PROJECT MANAGER: | | |
| AGENCY CONTACT: | | |
| ARCHITECT:CONSULTANT: | | |
| | | |
| Date for Substantial Completio Date for Final Completion: | n: | |

Contents

| <u>Article</u> | <u>Title</u> |
|----------------|--|
| '1 | Special Conditions Supplement |
| '2 | The Project |
| ' 3 | Project Contacts |
| ' 4 | <u>Times for Completion</u> |
| ' 5 | Liquidated Damages |
| ' 6 | Temporary Facilities and Controls |
| ' 7 | Special Inspections and Testing |
| ' 8 | Allowances |
| ' 9 | <u>Unit Prices</u> |
| '10 | Schedule of Additive Alternates |
| '11 | Additional Project Completion or Close-out Requirements |
| '12 | Special Project Site Security or Access Required |
| '13 | Special Delegated Design Requirements |
| '14 | Other Special Conditions of Contract |

Articles

'1 Special Conditions:

These Special Conditions are a provided as a supplement to the General Conditions in the Specifications. Special Conditions will also supersede General Conditions where changes are necessary to coordinate with specific project requirements.

'2 The Project:

These specifications and drawings accompanying them describe the work to be performed and materials to be furnished for the:

Elizabethtown Community and Technical College Student Center Renovation Elizabethtown, Kentucky Account No: 470-C88T-ET24-01

Project Description:

This project consists of the renovation of the existing approximately 18,000 GSF Student Center. The existing space will be converted into updated restrooms, classroom, offices, commercial kitchen, dining room and other support spaces. A new elevator will be installed inside the existing building along with a new outdoor elevated patio and new openings in the exterior wall. Base bid will include new rooftop mechanical units and associated roof patching. An add-alternate will be for the complete re-roof of the building. Site work will include a new outdoor mechanical yard, paving, and other site improvements. The building will receive all new mechanical and electrical systems throughout. Fire sprinklers will be installed and plumbing revisions as necessary to support the new spaces.

'3 **Project Contacts:**

(Refer to Drawings for Company Addresses / Phone Numbers)

In the roles defined by the General Conditions as "Architect" and as used throughout the Contract Documents as the Architect of the work being constructed, the following firm and its sub-consultants are working under separate contract with the Owner to provide the services under this role:

<u>Architect:</u> Company Name: <u>RossTarrant Architects</u>

Principal-In-Charge: Randy Brookshire
Project Manager: Michael Neureither

MEP Engineer: Company Name: Staggs & Fisher

Principal-In-Charge: Wayne Thomas
Project Manager: Chris Keath

Structural Engineer: Company Name: Brown + Kubican

Principal-In-Charge: Andy Barger
Project Manager: Nathan Jennings

In the roles defined by the General Conditions as "Owner" and as used throughout the Contract Documents as the Owner of the work being constructed, is the Commonwealth of Kentucky, acting through the Finance and Administration Cabinet, Department for Facilities Management and Support Services, Division of Engineering and Contract Administration. The Owner is solely represented by the following:

Owner: Finance and Administration Cabinet

Facilities and Support Services

Division of Engineering and Contract Administration

Project Manager: <u>Bill Novak</u>
Associate Director: <u>Frieda Myers</u>
Director: <u>Jennifer Linton</u>

In the role defined by General Conditions, "Agency or Using Agency", is a state government entity which utilizes the work being constructed. This agency is a client of the Owner and advises the Owner on matters related to the project. This Using Agency does not possess the legal authority of Owner:

<u>Using Agency:</u> Kentucky Community & Technical College System (KCTCS)

Project Manager: <u>Andy Casebier</u> Director: Andy Casebier

In the roles defined by the General Conditions as "Commissioning Authority" and as used throughout the Contract Documents as the Commissioning Agent of the work being constructed,, the following firm is working under separate contract with the Owner to provide the services under this role:

Commissioning Authority: Paladin, Inc.

In the roles defined by the General Conditions as "Special Inspector" and as used throughout the Contract Documents as the firm performing Special Inspections as required by the Kentucky Building Code for the work being constructed,, the following firm is working under separate contract with the Owner to provide the services under this role:

Special Inspector: ECS Southeast, LLP

'4 Times of Completion:

Subject to the conditions of Article '16 – "Delays and Extension of Time" of the General Conditions, the work to be performed under this Contract shall be completed as follows:

Substantial Completion shall be <u>330 (three hundred thirty)</u> Calendar Days from date of Executed Contract for Construction._Article '19.4 of the General Conditions set forth specific requirements of the Commonwealth of Kentucky that are necessary to be fulfilled by the Contractor in order to be determined to have accomplished Substantial Completion by this date. Refer to Article '11 of these Special Conditions for additional requirements of this specific project required to accomplish Substantial Completion.

Final Completion shall be <u>30 (thirty)</u> Calendar Days beyond Substantial Completion or Specific Date of Article '19.5 of the General Conditions set forth specific requirements of the Commonwealth of Kentucky that are necessary to be fulfilled by the Contractor in order to be determined to have accomplished Final Completion by this date. Refer to Article '11 of these Special Conditions for additional requirements of this specific project required to accomplish Final Completion.

As indicated in Article '4 of the General Conditions, "Construction Schedule", the following limitations of work times are set forth herein that are to be accounted for by the Contractor in scheduling and sequencing of the work:

Work Restrictions and "Black-Out" Dates: Coordinate w/ Elizabethtown Community and Technical College

Project Phasing (Separate start and completion dates): None.

Limitations on daily work times: None

Work being Performed by the Owner or by Others: Coordinate work related to communications connectivity and IT with Elizabethtown Community and Technical College and their vendors. Owner to provide the fiber connection into the building and the IT network equipment (UPS, switches, etc). Coordinate the delivery and installation of Owner provided equipment with Elizabethtown Community and Technical College and their vendors.

Products ordered by the Owner in Advance/ Anticipated Delivery Dates: Kitchen equipment provided by the Owner and installed by Contractor.

Construction Contract Time required for Commissioning: 516 Hours

Construction Contract Time required for Testing and Balancing: 5 days

'5 <u>Liquidated Damages / Damages from Untimely Performance:</u>

In accordance with Article '19.7 of the General Conditions, the Contractor shall pay the Owner the following identified amount for each and every calendar day of unexcused delay in achieving Substantial Completion and Final Completion beyond the date set for below for each:

Substantial Completion Liquidated Damages are \$921.00/calendar day for each day beyond the established Date of Substantial Completion until the Actual Date of Substantial Completion is achieved.

(See Article '19.4 of the General Conditions and Article '11 of these Special Conditions for requirements for Substantial Completion).

Final Completion Liquidated Damages are \$210.00/calendar day for each day beyond the established Date of Final Completion until the Actual Date of Final Completion is achieved. (See Article '19.5 of the General Conditions and Article '11 of these Special Conditions for requirements for Final Completion).

'6 Contractor Provided Temporary Facilities and Controls:

Construction Office/Trailer: To be located within construction/staging area; refer to General Conditions Article 8.11 for requirements.

Staging / Parking: To be located within construction and staging area. The contractor shall not utilize the Owner's paved parking areas.

'7 Special Inspections and Testing:

Article '12 of the General Conditions and the technical specifications of the Contract Documents define and establish the requirements and provisions for Inspection of the Work, Special Inspections performed by others working under separate contract with the Owner, and testing to be provided by the Contractor.

Structural Special Inspections and Testing: Refer to drawings and specification for extent of required special inspections. See notes below for additional requirements.

Site Special Inspections and Testing: Refer to drawings and specification for extent of required special inspections. See notes below for additional requirements.

- **7.1 Special Inspections & Testing**: In addition to the information outlined in Article 12 of the General Conditions, see additional requirements below:
 - Owner will employ services of an independent testing and inspection agency to perform specified
 testing required to be performed by the Owner under the Kentucky Building Code, and those items of
 Work listed below. Requirements listed in Article 12.5 of the General Conditions will also apply to
 these items of Work:
 - a. All inspections and testing of structural steel, masonry, and fabricators as identified on structural drawings and in specifications.
 - b. All inspections and testing of masonry, mortar and grout as identified in Division 04 of the specifications.
 - c. All inspections and testing of firestopping as identified in Division 07 of the specifications.
 - d. All inspections and testing items as identified in Division 31 of the specifications.
 - e. All inspections for Stone Base and Concrete Pavements as identified in Division 32 of the specifications.
 - f. All Subdrainage installation including drainage panels and piping for subgrade and retaining
 - g. Excavation and Backfill work for Utilities as identified in Division 33 of the specifications.
 - h. Fluid-Applied Waterproofing of Sub-Grade walls as identified in Division 07 of the specifications.

'8 Allowances included in the Contract Amount:

The Contractor is required by Article '30 of the General Conditions to include in the Contract Amount the following Allowances:

None.

Allowances shall include all necessary materials, costs of delivery, installation labor, tools and equipment necessary to provide the item or services indicated in the Allowance. When the item of work or service is completed, the Contact Amount is modified by Change Order to reconcile the Allowance with the actual cost of the item or service provided. The contractor's overhead, profit, insurance and bonds, and administrative costs are included in the prescribed markup permitted by Article '14 of the General Conditions "Changes in the Work" and are not to be included in the Allowance.

'9 Unit Prices established by the Form of Proposal:

The Contractor is required at time of submitting a bid proposal for this work to provide specific Unit Prices that will be used to add or deduct those specific work items or services by an established unit of measure and the stated price per unit.

Unit prices include all necessary materials, costs of delivery, installation labor, tools and equipment necessary to provide the unit measured item. If a unit price is used in a change to the work by Change Order, the contractor's overhead, profit, insurance and bonds, and administrative costs are included in the prescribed markup permitted by Article '14 of the General Conditions "Changes in the Work" and are not to be included in the unit price.

For a schedule of Unit Prices see the "Unit Prices" section of the Bid Form of Proposal.

9.A Rules of Measurement: The following Rules of Measurement shall apply in the use of Unit Prices:

- 1. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of a conflict, the requirements of the individual specification section shall govern.
- 2. Take all measurements and compute quantities. Measurements and quantities shall be reviewed by Architect.
- 3. Measurement Devices:
 - a. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
 - b. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
 - c. Metering Devices: Inspected, tested and certified by the applicable State department within the past year.
- 4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- 5. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness
- 6. Measurement by Area: Measured by square dimension using mean length and width or radius.
- 7. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- 8. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work

- Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of
 established unit prices and to have this work measured, at the Owner's expense, by an
 independent surveyor acceptable to Contractor.
- 10. Rules of Measurement:
 - a. All excavation and backfill for this project is considered to be unclassified.
 - b. Except as provision is made hereinafter for arbitrary measurements, the quantity of excavation shall be its in-place volume before removal.
 - c. No allowance will be made for excavating additional material of any nature taken out of the convenience of the Contractor, beyond the quantity computed under these Rules of Measurement.
 - d. The quantities of excavation shall be computed from instrument readings in vertical cross sections located at such intervals as will assure accuracy.
 - e. General excavation for buildings and sections of buildings, bases for equipment, sump pits, etc., involving an area of 200 or more square feet, shall be classified as "Mass Excavation".
 - f. Excavation for pipes, wall footings, grade beams, column footings, and sections of buildings such as bases for equipment, sump pits, etc., involving an area of less than 200 square feet, shall be classified as "Trench Excavation".
 - g. "Mass Excavation" shall be arbitrarily assumed to extend to vertical planes two (2) feet outside wall lines, and to the elevation of plan subgrade.
 - h. "Trench Excavation" for walls, grade beams, and sections of building, such as bases for equipment, sump pits, etc., involving an area less than 200 square feet shall be arbitrarily assumed to extend 2 feet wider than wall and grade beam thicknesses and outside walls of sections of buildings such as bases for equipment, sump pit, etc., but in no case less than three (3) feet wide sides vertical.
 - i. "Trench Excavation" for pipes shall be arbitrarily assumed to be two (2) feet wider than the outside diameter of the pipe barrel and with sides vertical.
 - j. "Trench Excavation" for wall footings and column footings shall be computed as vertical shafts, each with a horizontal cross section identical in shape and size with the plan of the footing.
 - k. The quantities of form work will be the area of forms in contact with concrete.
 - I. Concrete quantities shall be computed from plan size or if there are no drawings, from actual measurement of the work ordered and placed, waste excluded.

'10 Schedule of Additive Alternates:

The Bid Form of Proposal includes Additive Alternates that, if accepted by the Owner during review of bids, become a part of the Contract Amount. Additive Alternates are listed in the order which they will be considered and may be accepted by the Owner to be included in the base Contract of the Work. The following is the sequential listing and description of Additive Alternates:

- 1. Terrace addition, including but not limited to all structure and foundations, railings, lighting and new openings for storefront systems. Refer to drawings for more information.
- 2. Fit-out of the Coding Academy classroom. Refer to drawings for more information.
- 3. Fit-out of the Transfer Office Suite. Refer to drawings for more information.

Additive Alternates include all necessary materials, costs of delivery, installation labor, tools and equipment, contractor's overhead, profit, insurance and bonding, and administrative costs. All work necessary to provide the work described in the Additive Alternate is to be included.

'11 Additional Project Completion or Project Close-Out Required:

Article '19.4 of the General Conditions "Substantial Completion" defines the specific MANDATORY requirements to be accomplished or provided to achieve Substantial Completion of the Project. In addition to those requirements, the following requirements are also MANDATORY requirements to be accomplished or provided to achieve Substantial Completion of this Project:

- Any work of the project that requires any specific "manufacturer's representative's inspections such as
 roofing, mechanical equipment startup, etc (refer to specifications) the general contractor shall
 coordinate the timing of these inspections and certifications. All inspection warranties are to start
 from the date of Substantial Completion unless otherwise altered by the Director of the Division of
 Engineering. Inspections listed are to be included in the Construction Schedule as items with specific
 dates scheduled so as to meet the Date of Substantial Completion.
- Special Substantial Completion considerations for Owner Supplied, Contractor connected equipment
 and furnishings. The contractor shall advise the Owner of when Owner Supplied equipment needs to
 be delivered to the project site for installation. The Contractor shall be prepared and have the space
 adequately complete to accept Owner Supplied equipment. This shall be a line in the Construction
 Schedule with specific dates.
- Special Substantial Completion considerations of Owner installed systems (such as Voice/Data Systems, Security Systems, etc.). The contractor shall advise the Owner of the required date for the completion of Owner installed systems in order that the Contractor may complete their portion of the work. This shall be a line in the Construction Schedule with specific dates.

11.A System Start-Up:

- 1. Coordinate with General Commissioning Requirements.
- 2. For all systems:
 - a. Coordinate schedule for start-up of various equipment and systems.
 - b. Notify Architect and Owner seven days prior to start-up of each item.
 - c. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
 - d. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
 - e. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
 - f. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
 - g. Verify that wiring and support components for equipment are complete and tested.
 - h. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
 - i. Submit a written report that equipment or system has been properly installed and is functioning correctly.
- 3. For systems being commissioned, refer to the Commissioning Plan for start-up instructions.
- 4. For systems not being commissioned:
 - a. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
 - b. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

c. Verify that wiring and support components for equipment are complete and tested.

11.B Final Cleaning:

- 1. Execute final cleaning prior to final completion and before Owner occupancy.
- 2. Use cleaning materials that are nonhazardous.
- 3. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- 4. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- 5. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- 6. Clean filters of operating equipment.
- 7. Clean site; sweep paved areas, rake clean landscaped surfaces.
- 8. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

11.C Demonstration and Training

- 1. Training of Owner personnel in operation and maintenance is required for:
 - a. All software-operated systems.
 - b. HVAC systems and equipment.
 - c. Plumbing equipment.
 - d. Electrical systems and equipment.
 - e. Conveying systems.
 - f. Items specified in individual product Sections.
- 2. Training of Owner personnel in care, cleaning, maintenance and repair is required for:
 - a. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - b. Finishes, including flooring, wall finishes, ceiling finishes.
 - c. Fixtures and fittings.
 - d. Items specified in individual product Sections.
- 3. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- 4. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - a. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - b. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- 5. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - a. Perform demonstrations not less than two weeks prior to Substantial Completion.
- 6. Conduct training on-site unless otherwise indicated.
- 7. Owner will provide classroom and seating at no cost to Contractor.
- 8. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- 9. Provide training in minimum two hour segments.
- 10. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - a. Include applicable portion of O&M manuals.

- b. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
- 11. Training Records: Submit the following documentation to Architect and Owner:
 - a. Identification of each training session, date, time, and duration.
 - b. Sign-in sheet showing names and job titles of attendees.
 - c. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
- 12. Video Recordings: Submit digital video recordings of each demonstration and training session for Owner's subsequent use in DVD format. Label each disc and container with session identification and date.

Article '19.5 of the General Conditions "Final Completion" defines the specific MANDATORY requirements to be accomplished or provided to achieve Final Completion of the Project. In addition to those requirements, the following requirements are also MANDATORY requirements to be accomplished or provided to achieve Final Completion of this Project:

None

'12 Special Project Site Security or Access Requirements:

12.A Contractor Use of Site and Premises:

- 1. Construction Operations: Limited to areas noted on Drawings. Do not disturb portions of the site beyond the areas in which the Work is indicated.
- 2. Provide access to and from site as required by law:
 - a. Emergency Campus Exits During Construction: Keep all campus routes open during construction period unless otherwise shown on drawings; provide temporary directional signs if exit routes are temporarily altered.
- 3. Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
- 4. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to these areas. If additional storage is necessary, obtain and pay for such storage off site.
- 5. Pressure wash driveways where mud and debris from construction is generated on a regular basis.
- 6. The General Contractor shall conduct all his work, and the work of his subcontractors, without interruption of the business of the campus.
- 7. Workers shall abide by a code of conduct to include wearing shirts at all times. Alcohol, smoking, drugs, firearms, foul language, and fraternizing with students, staff or campus visitors is strictly prohibited.

'13 Special Delegated Design Requirements:

Not used

'14 Other Special Conditions of Contract:

14.A Project Reporting:

- 1. In addition to the information outlined in Article 8.5.2 of the General Conditions, include the following information in the Contractor's Daily Construction Reports:
 - a. Meter readings and similar recordings.
 - b. Orders and requests of authorities having jurisdiction.
 - c. Change orders received and implemented.
 - d. Construction change directives received.
 - e. Services connected and disconnected.
 - f. Equipment or system tests and startups.
 - g. Partial completions and occupancies.
- 2. Material Location Reports: At weekly intervals, prepare a comprehensive list of materials delivered to and stored at project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from project site.
- 3. Special Reports: When an event of an unusual and significant nature occurs at project site, whether or not related directly to the work, prepare and submit a special report. List chain of events, persons participating, response by contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Architect in advance when these events are known or predictable.

14.B Administrative Requirements:

- 1. Project Meetings: Project meeting attendance shall include those parties outlined in Article 31 of the General Conditions, as well as the following:
 - a. Special Inspections & Testing Agency
 - b. Commissioning Agent
- 2. Construction Photographs: Construction photographs provided shall be taken using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted. Provide images produced digitally at an image resolution of not less than 1600 x 1200, in JPG format; provide files unaltered by photo editing software.
- 3. Construction Schedule: In addition to those items noted within Article 4 of the General Conditions, include the activities where the Special Inspections & Testing Agency and Commissioning Agent will be required to be on site within the Time Frame of the Schedule.
- 4. Submittals: In addition to those items noted within Article 5 of the General Conditions, the following requirements apply:
 - a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - Coordinate transmittal of different types of submittals for related parts of the Work so
 processing will not be delayed because of need to review submittals concurrently for
 coordination.
 - i. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - c. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

- d. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - i. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - ii. Mark each copy of each submittal to show which products and options are applicable.
- e. Material color selections: Submittals for all interior finish colors shall be coordinated by the Contractor to be submitted in one interior finish color selection package.
- f. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- g. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
- h. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - i. Dimensions.
 - ii. Identification of products.
 - iii. Fabrication and installation drawings.
 - iv. Roughing-in and setting diagrams.
 - v. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - vi. Shopwork manufacturing instructions.
 - vii. Templates and patterns.
 - viii. Schedules.
 - ix. Design calculations.
 - x. Compliance with specified standards.
 - xi. Notation of coordination requirements.
 - xii. Notation of dimensions established by field measurement.
 - xiii. Relationship to adjoining construction clearly indicated.
 - xiv. Seal and signature of professional engineer if specified.
 - xv. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
- i. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - i. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - iii. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or

fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

iv. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

j. Informational Submittals:

- Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- ii. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- iii. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- iv. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- v. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- vi. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- vii. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- viii. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- ix. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment
- x. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- xi. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- xii. Manufacturer's Field Reports: Prepare written information documenting factoryauthorized service representative's tests and inspections.
- 5. Substitution Materials & Equipment: In addition to the requirements outlined in Article 9.3 of the General Conditions, comply with the following:

- a. Requests for substitution shall include the name of the material or equipment which is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
 - i. Substitutions merely for convenience are not permissible.
- b. Documentation: Provide evidence of the following:
 - i. Requested substitution does not require extensive revisions to the Contract Documents.
 - ii. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - iii. Requested substitution will not adversely affect Contractor's Construction Schedule.
- c. A request for substitution constitutes a representation that the submitter:
 - i. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - ii. Agrees to provide the same warranty for the substitution as for the specified product.
 - iii. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - iv. Waives claims for additional costs or time extension that may subsequently become apparent.
 - v. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- d. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

14.C Geotechnical Report:

1. Refer to Specification Section 012400 Geotechnical Data.

14.D Material Availability:

- Immediately following the award of Contract for this Work, Contractor shall determine sources of supply for all materials and length of time required for their delivery, including materials of subcontractors, and order shall be placed for such materials promptly. The Construction Schedule, which should incorporate delivery times, will be reviewed during the Pre-Construction meeting.
- 2. If, for any reason, any item specified will not be available when needed, and Contractor can show that he has made a reasonable, persistent effort to obtain item in question, the Architect is to be notified in writing, after contract issuance, and he will either determine source of supply or arrange with Owner for appropriate substitute within terms of Contract. Otherwise, the Contractor will not be excused for delays in securing material specified and will be held accountable if completion of building is hereby delayed.

END OF SPECIAL CONDITIONS

SECTION 004122 - MODIFIED BITUMINOUS ROOFING SYSTEM MANUFACTURER'S CERTIFICATION

PART 1 GENERAL

1.01 MODIFIED BITUMINOUS ROOFING SYSTEM MANUFACTURER'S CERTIFICATION

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

| Date Submitted: | |
|--|--|
| Name & Address of Roofing Systems Manufactu | rer: |
| | |
| Name & Address of Roofing Systems Installer: | |
| | |
| I certify that applicator of our roofing systems, and upon complete conditions for the manufacturer's guarantee are manufacturer's guarantee for the roof. | (Name of Roofing Installer) is an approved pletion of this project, providing all terms and net, we will provide a no-dollar-limit 20-year |
| Signed: | Title: |
| (Roofing Systems Manufacturer) | |

END OF SECTION 004122

This certification must be completed and submitted as outlined in the Supplemental Instructions to

SECTION 004138 - FINISH HARDWARE SUPPLIER'S CERTIFICATION PART 1 GENERAL

1.01 FINISH HARDWARE SUPPLIER'S CERTIFICATION

Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal. Date Submitted: Name & Address of Finish Hardware Supplier: (print or type name of employee) is a current I certify that member of the Door and Hardware Institute (DHI), certified by DHI as an Architectural Hardware Consultant. I further certify that this person has fulfilled the educational experience requirements of the DHI's Continuing Education Program for Consultants and is authorized by DHI to use the Official Seal. All hardware for this project shall be scheduled and furnished by or under direct supervision of the person listed above, who is also a full-time employee of the firm listed above. DHI Membership Number DHI Official Seal Valid Through_____(Date)

Signed: _____Title: _____

END OF SECTION 004138

SECTION 012400 - GEOTECHNICAL DATA

PART 1 GENERAL

1.01 GEOTECHNICAL REPORT

- A. A geotechnical exploration of the site was conducted by ECS Southeast, LLP, dated July 16, 2020.
 1. A digital copy in color may be requested of the Architect.
- B. The report of the geotechnical exploration is appended hereto for reference only and is not a part of the Contract Documents. The boring layout and log of borings is appended to the set of contract drawings. No warranty of content or accuracy is expressed or implied. Neither the Owner nor the Architect will be responsible for interpretations or conclusions drawn from this report by the Contractor. This data is made available solely for the convenience of the Contractor.

END OF SECTION







ECS Southeast, LLP

Geotechnical Engineering Report ECTC - Student Center Renovations

600 College Street Road Elizabethtown, Kentucky 42701

ECS Project Number 61:2331

July 16, 2020



Geotechnical • Construction Materials • Environmental • Facilities

July 16, 2020

Commonwealth of Kentucky
Division of Engineering & Contract Administration
Finance & Administration Cabinet
403 Wapping Street, 1st Floor
Frankfort, Kentucky 40601

Attention: Mr. William H. Novak

ECS Project No. 61:2331

Reference: G

Geotechnical Engineering Report

ECTC - Student Center Renovations

600 College Street Road

Elizabethtown, Kentucky 42701

Dear Mr. Novak:

ECS Southeast, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with ECS Proposal No. 61:P1948, dated June 4, 2020. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our geotechnical related design and construction recommendations.

It has been our pleasure to be of service to Commonwealth of Kentucky during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and would like to provide our services during construction operations as well to confirm the interpreted subsurface conditions utilized in this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southeast, LLP

William "Grant" Hess, GIT

Project Geologist

GHess@ecslimited.com

Vandevelde, P.E.

Principal Engineer

GENAND ever de @ecslimited.com

VANKentucky License No. 14708

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APPENDICES

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- Boring Location Plan

Appendix B - Field Operations

- Soil & Rock Classification
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Appendix C - Laboratory Testing

- Field Procedures
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- California Bearing Ratio (CBR) Test Report

Appendix D – Supplemental Report Documents and Calculations

ASFE "Important Information About Your Geotechnical Engineering Report"

EXECUTIVE SUMMARY

The following conditions were characteristic of the encountered site and subsurface conditions:

- The site consisted of approximately 3.5 acres of developed land with an existing 2-story building and associated underground utilities, sidewalks, and landscaped areas within the ECTC campus.
- The site sloped down to the north with approximately 6 feet of fall across the south side building addition areas, and approximately 25 feet across the entire site.
- Surface materials generally consisted of approximately 4 to 5 inches of asphalt underlain by approximately 4 to 6 inches of crushed stone, or approximately 3 to 9 inches of topsoil.
- Existing fill consisting of silty clay with varying amounts of chert, root fibers, and debris was encountered below the surface in five borings and extended approximately 1.1 to 3.5 feet below existing grades.
- Surface materials or fill was underlain by low to moderate plasticity, soft to very stiff, moist to very moist, silty clay that transitioned to high plasticity, firm to very stiff, moist to very moist, silty clay or underlain directly by the high plasticity clay.
- Borings were extended to approximately 15.5 feet below existing grades.
- Groundwater seepage was observed sporadically within 4.0 to 15.5 feet below existing grades in six borings at the time of drilling.

GEOTECHNICAL CONCERNS:

- Adjacent Structures
- Existing Utilities
- Existing Surfaces
- Existing Fill

- Plastic Clays
- Low Strength Soils
- Karst Conditions
- Groundwater Seepage
- Degradable Soils
- Reuse of On-Site Soils
- Subgrade Improvement
- Weather Considerations

DESIGN & CONSTRUCTION RECOMMENDATIONS:

- Subgrade elevations and site excavations should be evaluated by a ECS representative for evidence of karst activity.
- The management of the moisture of on-site soils will be an important component in addressing the concerns
 associated with plastic clays, including, but not limited to, controlling the moisture of fill materials, not
 allowing subgrades and foundation excavations to desiccate during construction, and reducing long term
 moisture fluctuations.
- If encountered, the existing fill may be left in-place in floor areas if the owner is willing to accept the
 associated risks, no unsuitable materials are detected in the fill by ECS, and the existing fill is stable under
 proofrolling.
- The proposed addition may be supported on conventional shallow foundations bearing on firm to stiff or stronger undisturbed inorganic clay or Structural Fill as defined in this report. The following net allowable design bearing pressures may be used in foundation design:
 - 2,500 psf for continuous wall foundations.
 - 3,000 psf for isolated column foundations.
- Plan new foundations to bear at the same level as the existing building foundations. Alternately, retention and/or underpinning of the existing foundations may be necessary.
- Design the addition to reduce impact on the existing structure and accommodate potential differential settlement with respect to the existing building.
- Floors may be designed as slabs-on-grade with a subgrade modulus of 100 pci.
- A site class of "C" may be used in seismic design per the 2018 Kentucky Building Code.
- All foundation excavations and floor subgrades should be evaluated by an ECS representative during construction to confirm that encountered conditions are consistent with the findings of this exploration
- Flexible and/or rigid pavements may be used in proposed pavement areas. Rigid pavements should be
 considered for entranceways, dumpster pads, or other areas where heavy vehicles will turn on a tight radius
 or be parked for extended periods of time.

This summary should not be considered apart from the entire text of the report with the complete qualifications and considerations mentioned herein. Details of our conclusions and recommendations are discussed in the report text.

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information for the design of floors, foundations, and pavements for the proposed additions and renovations. The recommendations developed for this report are based on project information supplied by the Commonwealth of Kentucky.

This report contains the results of our subsurface exploration and laboratory testing programs, site characterization, engineering analyses, and recommendations for the design and construction of the planned structures and pavements.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following:

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features, site conditions, and geologic conditions.
- A review of subsurface soil and rock stratigraphy with pertinent available physical properties.
- Boring Records for the borings conducted for this report and general subsurface profiles.
- Recommendations for site preparation and construction of compacted fills, including an
 evaluation of on-site soils for use as compacted fills and identification of encountered
 potentially unsuitable soils.
- Recommended foundation type(s), design parameters (including lateral earth pressure coefficients), and construction evaluations.
- Recommended slab on grade design parameters and construction guidelines.
- Site Class for seismic design based on the boring data and on available data from the vicinity.
- Recommended pavement design parameters and construction guidelines.

2.0 PROJECT INFORMATION

2.1 SITE INFORMATION

| SUBJECT | SUMMARY OF EXISTING SITE CONDITIONS |
|------------------------|--|
| Site Address | The site was located within the Elizabethtown Community and Technical College (ECTC) campus at 600 College Street Road in Elizabethtown, Hardin County, Kentucky 42701. Refer to Site Vicinity Map in Appendix for approximate location of site. |
| General Description | The existing site consists of approximately 3.5 acres of developed land with the existing ECTC student center and associated sidewalks and landscaped areas. The existing ECTC student center has a walkout basement level. |
| Topography | The existing site sloped down to the north with approximately 6 feet of fall across the building addition area and approximately 25 feet across the entire site. |
| Surface Water Drainage | Surface drainage appeared to be fair to good. |
| Ground Cover | Asphalt pavement, concrete sidewalk, and short grass lawns with isolated trees. |
| Existing Utilities | Marked underground utilities traversed the proposed construction footprint at the time of drilling. |

2.2 PROPOSED CONSTRUCTION

| SUBJECT | DESIGN INFORMATION / EXPECTATIONS |
|-----------------------------|--|
| Project Description | The renovations will consist of an addition an elevator and stair tower with |
| | elevator walkway on the south face of the building, new asphalt drives, |
| | parking areas, concrete curbs and walks, and associated site improvements. |
| | The proposed addition will consist of load bearing concrete masonry walls |
| | with brick veneer. |
| # of Stories | 2-story above grade |
| Usage | Institutional, education |
| Maximum Column Loads | 150 kips (assumed) |
| Maximum Wall Loads | 5 kips per linear foot (assumed) |
| Finish Floor Elevation | To match the existing finished floor elevation. |
| | 1 st Floor (basement): EL 742.01 to 742.05 |
| Maximum Cut/Fill | ± 1 feet (estimated) |
| Conversations/E-mail | Anne St-Aignan Muller of Commonwealth of Kentucky, Division of |
| | Engineering & Contract Administration, Finance & Administration Cabinet. |
| | |
| | William H. Novak of Commonwealth of Kentucky, Division of Engineering & |
| | Contract Administration, Finance & Administration Cabinet. |
| Project Information Sources | "SITE BORING PLAN, DRAWING NO. BP1.0", prepared by Rosstarrant |
| | Architects, provided by Anne St-Aignan Muller of Commonwealth of |
| | Kentucky via email dated May 28, 2020. |
| | UDbass A Coborittal Descriptor Elizabethtown Community O Tableiral |
| | "Phase A Submittal Drawings, Elizabethtown Community & Technical |
| | College Student Center Renovation, Account No.: 470-C88T-ET24-01", |
| | prepared by Rosstarrant Architects, dated June 05, 2020. |
| | "ECTC ExTopo.dwg" prepared by American Engineers, Inc., submitted to |
| | eComm on June 17, 2020. |

3.0 SITE GEOLOGY

According to the Geologic Map of the Cecilia 24K Quadrangle, Hardin County, Kentucky, published by the United States Geological Survey (USGS), and information obtained from the Kentucky Geological Survey (KGS) Geologic Information Service website, the subject site was underlain by the St. Louis Limestone formation.

| Site Geology - Underlying Formations ⁽¹⁾ | | |
|---|---|--------------------------------|
| FORMATION | DESCRIPTION | KARST POTENTIAL ^{2,3} |
| St. Louis Limestone | a) Limestone: Yellowish-gray, olive-gray, and medium | Very High Karst⁴ |
| (Upper | bluish gray; fine to medium grained and/or very fine | |
| Mississippian) | to fine grained; thin to thick bedded and/or massive, | |
| | argillaceous, dolomitic, silty, limestone. Contains | |
| | several zones of gray chert, some irregular and | |
| | scattered and some nodular along bedding planes. | |
| | b) Dolomite: Light olive gray and weathers yellowish | |
| | gray; very fine grained to fine grained, thin to thick | |
| | bedded, sparry, dolomite. Contains fist-sized pockets | |
| | of crystalline calcite. | |
| | c) Shale: Yellowish green to dark brown, calcareous, and | |
| | carbonaceous; thin bedded, shale. Commonly | |
| | contains chert and silicified limestone occurring in | |
| | irregular to smooth tabular masses with thick | |
| | persistent zone near base. | |
| | d) Weathers to mature karst topography with few | |
| | exposures except in sinks or along major streams. | |
| | e) Soil cover is generally 30 to 40 feet thick, reportedly as | |
| | much as 100 feet thick. | |

Notes:

- (1) Source: Geologic Map of the Louisville East and Jeffersonville, 24K Quadrangle, Kentucky, published by the United States Geological Survey, and information obtained from the Kentucky Geological Survey Geologic Information Service website.
- (2) Karst is topography commonly formed over limestone and characterized by sinkholes, irregular rock conditions, underground drainage, springs, and caves.
- (3) The karst potential is based on the tendency for the unit to develop or have karst features as shown on the Kentucky Geological Survey (KGS) Geologic Information Service Karst Potential Map and is not necessarily indicative of the actual presence or absence of existing karst activity at the site.
- (4) According to the KGS Karst Potential Classification definitions, formations designated with a "Very High" karst potential are where formations will exhibit mature karst, including caves, sinkholes, and springs where they crop out."

4.0 FIELD EXPLORATION AND LABORATORY TESTING

4.1 SUBSURFACE CHARACTERIZATION

| SUBJECT | SUMMARY OF SUBSURFACE EXPLORATION ⁽¹⁾ | | | |
|-------------------|--|--|--|--|
| Boring Method | Continuous Auger. | | | |
| Sampling Method | Standard Penetration Testing (ASTM D-1586). | | | |
| Number of Borings | Twelve (12) total borings to 15.5 feet below existing grades. | | | |
| Boring Locations | Refer to Boring Location Plan in the Appendix for specific locations. | | | |
| Boring Depths | Refer to Boring Records in the Appendix . | | | |
| Logging Method | Full-time presence of an ECS engineer to observe, direct, and document the drilling, sampling and testing results, and encountered conditions. Water level measurement in boreholes during drilling. | | | |
| Groundwater | Groundwater seepage was observed sporadically within 4.0 to 15.5 feet below existing grades in six (6) borings at the time of drilling. | | | |
| Refusal (2) | Refusal was not encountered at the time of drilling. | | | |

Notes:

- (1) Detailed descriptions of the exploration methods are listed in the Field Procedures section of the Appendix.
- (2) Refusal is the term applied to material that cannot be penetrated with augers or has a standard penetration resistance exceeding 50 blows per 6-inch increment or 10 blows with little to no penetration of the splitspoon. Refusal may be encountered on continuous bedrock, discontinuous floaters, cemented soil, weathered rock, debris, buried structures, or other hard subsurface materials.

The following sections provide generalized characterizations of the soil strata. Please refer to the **Boring Records** and **Boring Composite** in the Appendix.

| APPROXIMATE DEPTH (FT) | STRATUM | DESCRIPTION | N-VALUES BLOWS PER FOOT (BPF) | |
|---------------------------|---------|--|--|--|
| 0.0 – 0.8 | | PAVEMENT – Approximately 4 to 5 inches of asphalt underlain by approximately 4 to 6 inches of crushed stone encountered at the surface materials in two (2) borings. | N/A | |
| | | TOPSOIL – Approximately 3 to 9 inches of topsoil encountered at the surface materials in ten (10) borings. | | |
| 0.7 – 3.5 | II | EXISTING FILL (FILL) – Various shades of brown, red, orange, and gray, low high plasticity, soft to stiff, moist, (FILL), with varying amounts of chert, root fibers, and debris. Encountered below Stratum I in five (5) borings. | 3 to 10 | |
| 0.8 – 7.8 | III | CLAY (CL) – Brown and/or orange brown, low to moderate plasticity, soft to very stiff, moist to very moist, silty clay, (CL), with trace black oxide nodules, chert, and root fibers. Encountered below Stratum I or II in five (5) borings. | 3 to 11 | |
| 0.8 – 15.5 | IV | CLAY (CH) – Red brown, yellow brown, and/or mottled gray, moderate to high plasticity, firm to very stiff, moist to very moist, silty clay, (CH), with trace black oxide nodules and varying amounts of chert. Encountered below Stratum I, II, or III in all borings. | 3 to 12 | |

Notes:

(1) This summary is generalized and does not describe the actual conditions in all borings. All zones do not occur at each location. Depths are approximate. Detailed descriptions of the encountered materials are listed on the Boring Records in the Appendix.

4.2 LABORATORY TEST SUMMARY

The laboratory testing was performed on selected samples obtained during our field exploration operations. Classification and index property tests were performed. The laboratory testing program included:

- Natural Moisture Content
- Atterberg Limits
- Hydrometer Test
- Swell Test, Expansion Index
- California Bearing Ratio
- Shrinkage Limit

Each sample was visually classified on the basis of texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures), including Unified Soil Classification System (USCS) classification symbols, and ASTM D2487 Standard Practice for Classification for Engineering Purposes. After classification, the samples were grouped in the major zones noted on the Boring Records in the Appendix. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual.

| | SUMMARY OF LABORATORY TEST RESULTS ⁽¹⁾ | | | | | | | | |
|------------|---|-------------------------|-----------------|------------------------------------|-----------------|------------------|---------------------|-----------------------------------|-----------------------------|
| STRATUM | MOISTURE CONTENT | SIEVE WASH (% Fines) | EXPANSIVE INDEX | STANDARD PROCTOR ⁽²⁾ | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT ⁽³⁾ | UNIFIED SOIL CLASSIFICATION |
| III and IV | 1 | | 1 | 110.0 pcf @ 15.9% | | 1 | | | (CL) & (CH) |
| III | 18.0 – 23.3 | | | | 32 | 14 | 18 | 11 | (CL) |
| IV | 24.4 – 45.3 | 81 – 83 | 0-6 | | 55 – 72 | 21 – 23 | 32 – 51 | 12 – 15 | (CH) |

Notes:

- (1) A more detailed summary of the laboratory test results is included on the Boring Records in the Appendix. Detailed descriptions of the laboratory test methods are listed in the Laboratory Procedures section of the Appendix.
- (2) Standard proctor values represent the optimum dry density in pounds per cubic foot at the optimum moisture content.
- (3) Shrinkage limit estimated per estimated (SL) per Casagrande Estimation. Source: Holtz & Kovacs (1981) An Introduction to Geotechnical Engineering, Prentice-Hall, New Jersey, pp. 182-184.
- (--) Not measure or encountered.

5.0 GEOTECHNICAL CONCERNS

Analysis of the provided project information, observed site conditions, encountered subsurface conditions, and our past experience with similar projects, revealed the following important geotechnical considerations. These considerations must be properly addressed in planning, budgeting, design, and construction phases to reduce impacts on construction cost, completion schedule, performance of the building and site improvements, and long-term maintenance of the proposed construction. Our recommendations for addressing these concerns are provided in subsequent sections of this report.

5.1 ADJACENT STRUCTURES

- The presence of the existing building will affect the design and construction of the proposed addition. If the presence of the existing building is not properly considered during design and construction, the existing building could be damaged.
- Excavation, foundation installation and other construction activities for the proposed addition could disturb or undermine the existing structure. It is our understanding that the proposed addition foundations near the existing building will bear at the same elevations as the existing building foundations.
- New soil-supported loads can cause settlement of existing soil bearing structures. If new loads will be imposed on or adjacent to existing soil bearing foundations, damage to the existing building due to settlement may occur.
- Differential settlement between the proposed addition and the existing building should be anticipated and considered in the design. A bond breaker may be required between proposed and existing foundation systems if load transfer is not desired.
- It is our understanding that proposed addition foundations will be constructed adjacent to
 and in close proximity to existing shallow foundations. Sloped or benched excavations,
 temporary bracing, or other suitable stabilization measures, may be required in these areas
 since excavation depths may exceed 10 feet.
- Recommendations in this report have been provided to reduce the adverse impacts of the new addition on the existing building.

5.2 EXISTING UTILITIES

- Marked underground utilities traversed the proposed construction footprint at the time of drilling.
- If existing underground utilities are abandoned and not removed or grouted full, soil may migrate into open voids (e.g., open pipes from utilities), causing subsidence of the overlying construction.
- In addition, existing utility lines located within proposed construction areas may cause the new construction to behave unexpectedly due to the variable and poor support conditions caused by old backfill, which can cause settlement or distress of the overlying new construction. Existing utility backfill rarely is suitable for support of new structures.
- The load support characteristics of the backfill along utility lines typically can be assessed with careful proofrolling and subgrade evaluation during construction. Some undercutting and/or bridging of these backfill areas should be anticipated.

5.3 EXISTING SURFACES

- Portions of the proposed construction footprint consisted of hardscape and asphalt pavement.
- Existing hardscape and pavements should be left in-place as long as possible to act as a construction platform.
- Water is commonly trapped under surface paving. Accordingly, soft, saturated soils may be present in some areas below existing pavement.
- Water seepage into excavations from the existing gravel base and utility backfill should be anticipated.
- Moisture conditioning of soils underlying these surface materials commonly is necessary and should be anticipated for this project.
- In addition, landscape and pavements commonly obscure the presence of soft soils. Some undercutting of soft soils below these surface materials should be anticipated.

5.4 EXISTING FILL

- Existing fill, extending approximately 1.1 to 3.5 feet below existing grades, was
 encountered in five (5) borings (B-103, B-104, B-105, B-108, and B-109) below the surface
 materials. The existing fill consisted of silty clays with varying amounts of chert, root fibers,
 and debris.
- Potential problems for the proposed construction created by the presence of the existing uncontrolled fill include: larger than normal total and differential settlements, collapse of unstable buried objects, and poor bearing support. The manifestation of these problems can cause poor foundation and slab performance.
- Support of new foundations over or in the existing fill is not recommended. Foundations must penetrate the existing fill, or the existing fill must be removed and replaced with Structural Fill or flowable fill.
- Support of new floors over the existing fill is feasible provided the fill is evaluated by ECS at
 the time of construction, is improved as indicated by ECS, determined to be stable under
 proofrolling during construction, and the Owner is willing to accept an elevated risk for
 future slab support issues associated with the fill.

5.5 PLASTIC CLAYS

- Plastic clays (i.e., plasticity index greater than 30 generally designated as "CH" in report and on boring logs) were encountered in the borings.
- Plastic clays are expected to be encountered near or above the floor and foundation bearing levels in the building addition and some pavement areas.
- Plasticity clays are susceptible to volume changes with changes in moisture. Accordingly, it
 is advisable to reduce the potential for moisture changes to the soil because of the
 shrink/swell concerns and the possible impact on the proposed structure.
- Volume changes associated with the plastic clays in the project vicinity can produce slight
 to moderate building damage (e.g., foundation and floor cracks, wall distortions and
 cracking, floor heave, or door/window alignment problems). Movement may be cyclic
 (shrink when dry, swell when wet), continuing to produce building distortions that require
 increased maintenance or repair. Typically, the volume changes are not of the magnitude
 to result in severe structural damage to buildings if handled appropriately in design and
 construction.

- There is a risk for greater than normal displacement and damage to lightly loaded structures, floor slabs, pavements, sidewalks, etc. that are directly underlain by these materials.
- Moisture control of plastic clays, when used as fill, also may be difficult to achieve since
 they can be slow to dry and slow to absorb moisture. Exposure to wet or dry weather
 conditions can result in problems achieving the required compaction levels.
- Most of the effects of plastic clays can be greatly reduced by employing the design and construction controls described in this report.
- The following steps can help reduce the risk for problems related to these materials:
 - Where plastic clays with a plasticity index greater than 30 are exposed in footing excavations adjust moisture content to 2% above standard proctor (ASTM D-698) optimum moisture content. For all plastic clays, place concrete the same day as excavations are opened.
 - Downspouts and surface drainage should be designed to direct water away from buildings to reduce moisture changes of the foundation soils.
 - Proper spacing, variety selection and irrigation should be used for trees and shrubbery planted near the building to reduce the risk for soil desiccation caused by water uptake by the plant roots.
- The risks associated with plastic clays are common for the project vicinity and are not unique to the site.
- These risks can be reduced by replacement of the plastic clays with lower plasticity fill or by lime treatment.

5.6 LOW STRENGTH SOILS

- Low strength silty soils (soft to firm) were encountered (typically upper 4.0 to 6.5 feet) in the drive lanes and asphalt parking renovations in the northern portion of site.
- The low strength silty soils may be unstable, and "pump" when subjected to construction equipment, especially under wet conditions.
- Exposure to wet or dry weather conditions may result in the need to adjust moisture contents to achieve the desired compaction and fill texture.
- Improvement of the weaker soils should be expected in some areas, with the lateral extent and depth of improvement increasing during wetter periods of the year. Improvement of some of the firm soils also may be necessary.
- All soft soils, where encountered at floor and foundation subgrades, must either be undercut or stabilized during construction.
- Exposure to wet or dry weather conditions may result in the need to adjust moisture contents to achieve the desired compaction and fill texture.
- The extent of low strength soils will typically be reduced if earthwork takes place during the warmer, drier summer and fall months.

5.7 KARST CONDITIONS

 The limestone formation underlying the site has a reported very high potential for karst features: a highly irregular rock surface; isolated rock slabs or "floaters"; sinkholes; soilfilled or open joints and bedding planes; and springs.

- No closed depressions or sinkholes were observed on the site at the time of drilling.
 However, several karst features were mapped within 1500 to 2000 feet of the site according to the KGS Geologic Map Information Service.
- Existing fill and hardscape surface could obscure evidence of karst activity.
- Construction in karst areas presents risks that the owner must be willing to accept. The primary geotechnical risks include:
 - Settlement, subsidence and/or collapse of the subsurface materials.
 - Deposits of unsuitable soft and/or organic soils in existing sinkholes.
 - Deep cuts increase risk and create a greater exposure to incipient karst features.
 - Irregular upper rock surface, discontinuous rock layers, highly weathered rock, and generally variable conditions.
 - Poor correlation between refusal depths and the actual depth to rock.
- Site development costs typically are higher in karst areas due to the costs associated with reducing the karst risks during design and construction.
- However, the risks associated with karst geology are common for the project vicinity and are not unique to the site. These risks can be reduced, but not eliminated, by following the recommendations in this report.

5.8 GROUNDWATER SEEPAGE

- Groundwater seepage was observed sporadically within 4.0 to 15.5 feet below existing grades in six (6) borings at the time of drilling.
- Water seepage, even minor seepage, commonly degrades subgrades and bearing surfaces when planned for inadequately or inappropriately.
- The seepage of perched/trapped water could impact excavations, because the seeping water tends to lower stability and cause sidewall collapse, requiring even shallow excavations to be laid back or braced.
- Isolated zones of perched water can exist within cherty zones of the soils, existing fill, below pavements and hardscape surface or at the top of the soil/rock interface.
- Construction documents should include provisions for removal of seepage should it occur in excavations.

5.9 DEGRADABLE SOILS

- Most of the soils on-site are susceptible to degradation. Degradable soils readily lose strength, become unstable, and "pump" when subjected to construction equipment, especially under wet conditions.
- Undercutting and/or stabilization of unstable clay soils could have a cost impact on the
 project, especially if not properly addressed in the project documents (e.g., definition of
 what is unsuitable and whose responsibility maintenance of these soils is once stabilized)
 or if not properly addressed during construction (e.g., subjected to repeated construction
 traffic with no protection).

5.10 REUSE OF ON-SITE SOILS

• In general, most of the on-site soils appeared suitable for reuse as Structural Fill provided the soils are moisture conditioned to appropriate moisture contents for compaction.

- Most of the existing fill encountered in our borings appeared to be suitable for reuse provided no unsuitable materials are excavated and the soil is moisture conditioned prior to compaction
- Some wetting, drying, mixing or chemical treatment of the soils may be necessary to obtain workable moisture contents for the on-site soils, especially during wetter times of the year.
- High moisture problems should be expected in borrow areas where deep cuts are required.
- Sorting to remove unsuitable or oversized material from the existing fill should be expected.

5.11 SUBGRADE IMPROVEMENT

- Widespread subgrade improvement is not anticipated but localized improvement may be needed to address areas where plastic clays are exposed at floor and foundation subgrades.
- The required extent of improvement will depend to a large degree on when earthwork operations take place as well as on how the earthwork contractor prepares the site. The level of improvement likely will increase if:
 - Construction traffic is concentrated along localized unstabilized routes.
 - Earthwork occurs during cool, wet periods (typically November through May).
- Provided construction occurs during the drier time of the year, it would be our expectation
 that much of the improvement could be achieved by scarifying, drying and recompacting
 the soils.
- If construction occurs during the wetter periods of the year, more aggressive treatment would be required (i.e., removal and replacement or lime drying).
- Subgrade improvement alternatives, if required, include but are not limited to:
 - Scarification, drying, and recompaction of surface materials.
 - Removal of unsuitable materials and replacement with controlled fill.
 - Bridging with a thick lift of limestone aggregate.
 - Placement of a geosynthetic or geo-grid in combination with granular fill.
 - Chemical stabilization and/or modification (e.g., kiln dust, lime, or Portland cement).
- Some of the subgrade improvement alternatives provided above are affected by the weather considerations described previously. For example, scarification, drying, and recompaction of surface materials would be difficult during the cool, wet months of the year.

5.12 WEATHER CONSIDERATIONS

- Conducting site work during periods of cool and/or wet weather (typically November to May) can be problematic for sites in the project region.
- Proper compaction of clay fill generally is very difficult to achieve during periods of cool and/or wet weather.
- Some drying, mixing, or chemical treatment of the soils would be necessary to obtain workable moisture contents for the on-site soils or proposed borrow materials if placed during the cool, wet seasons.
- If compaction of clay fill takes place under wet weather conditions, increased earthwork
 costs, an extended construction schedule, and soil improvement (likely chemical
 stabilization) likely would be required. In addition, reuse of the site soils may be severely
 limited.

- Surface soils tend to be softer during wet weather conditions due to the excess moisture in the near surface soils.
- Weather-softened surface soils tend to result in more undercutting and/or stabilization than would be required during dry weather conditions, which increases site development costs.
- Project specifications should include definitions and unit rates for subgrade stabilization, removal of unsuitable soils, and replacement of unsuitable soils with Structural Fill appropriate for use during the anticipated construction season.

6.0 SITE CONSTRUCTION RECOMMENDATIONS

6.1 PLANNING

 Adjust project plans, specifications, schedules and budgets to incorporate the issues discussed in Section 5.0 and the recommendations provided herein.

6.2 DEMOLITION

- Locate all existing structures and utilities before construction begins to assess their impact on the proposed construction.
- Remove, where possible, pavements, buried utilities and associated disturbed soils from the proposed construction limits.
- Demolition contractor should be directed to demolish in-place and lift existing building elements out of the ground (avoid pushing) to reduce disturbance of adjacent subgrades.
- Excavations adjacent to the existing building must be excavated with care so as not to disturb existing slab, foundations or foundation soils.
- Backfill the resulting excavations and disturbed soil with properly placed and compacted Structural Fill that is keyed into the native soil in one-foot steps to provide a gradual transition in support conditions.
- Existing and abandoned utilities should be removed in their entirety with the resulting excavation backfilled in accordance with the recommendations in this report (including benching side slopes and proper compaction).
- Where abandoned utilities must be left in place, the ends should be plugged with concrete and the pipes should be grouted full.

6.3 SUBGRADE PREPARATION

 The following sections describe our general recommendations for preparing the site subgrade prior to fill placement operations.

Stripping and Grubbing:

- Materials required to be stripped:
 - Vegetation, topsoil, asphalt, concrete, gravel, organic material, and excessively wet, desiccated, frozen, contaminated or otherwise unsuitable materials.
 - Refer to subsequent section for recommendations related to existing fill.
- Minimum extent of stripping:
 - 10 feet beyond the building limits.
 - 5 feet beyond the pavement limits.
 - 5 feet beyond the toe of structural fills.
- ECS should observe and document that topsoil and unsuitable surficial materials have been removed prior to the placement of Structural Fill or construction of structures.
- Stripped material not meeting Structural Fill requirements should be considered for reuse in landscaped areas only.

Low Strength Soils:

- The upper layers of soft to firm soils encountered in the northern portion of the site were not suitable for providing the required pavement support.
- Based on the conditions encountered in the borings, the surface soils will require undercutting and/or stabilization to achieve a suitable construction platform and fill base. The actual need for and/or extents of undercutting in these areas will be determined at the time of construction based on the actual conditions encountered at that time, and planned grading.

Subgrade Evaluation:

- Proofroll the site in the presence of an ECS representative with a pneumatic-tired vehicle (e.g., triaxial dump truck) loaded as recommended by the ECS representative.
- Proofroll subgrades prior to filling or after excavation to grade.
- Proofroll slab and pavement subgrades prior to granular base placement.
- Areas judged by the ECS representative to deflect excessively during proofrolling should be remediated in accordance with the recommendations provided at that time.
- Prepare subgrades with a slight slope to maintain surface drainage.

Other Measures:

- Roll subgrade surfaces smooth if rain is expected.
- Slope final subgrades away from the proposed structure.
- Rough grade subgrades high to allow for removal of degraded soil.
- Remove soil frozen or softened by rain.

6.4 UNCONTROLLED FILL

Foundations:

- The recommendations contained in this report were based on the assumption that the existing fill is uncontrolled fill.
- All existing fill should be removed in the proposed addition foundation bearing areas.
- Replacement fill should be placed and compacted in accordance with the recommendations provided in this report.
- The foundations are anticipated to penetrate the existing fill depths encountered and should not be affected by the risks associated with existing fill.

Slab & Pavement Areas:

- The existing fill may be left in-place in the pavement areas provided:
 - The Owner accepts the risks associated with the leaving the existing fill in-place.
 - Visual observation and proofrolling evaluation of the subgrade by a ECS representative at the time of construction.
 - Fill subgrade judged stable by ECS under suitable proofroll load or improvement of the subgrade where and how recommended by ECS based on the results of proofrolling and observations.

• If the risks associated with the existing fill, as described in this report, are not acceptable to the owner, the existing fill in the building and pavement areas should be removed and replaced with Structural Fill, likely requiring mass removal and replacement prior to construction of the overlying building addition.

6.5 PLASTIC CLAYS

- The measures provided below will reduce but not eliminate the risk that the proposed construction will be impacted by the presence of plastic clays. However, if the risk associated with high plasticity clays is not acceptable, then no high plasticity clays (i.e., plasticity index greater than 30) should be present within 2 feet of the proposed subgrade or foundations.
 - If high plasticity clays are exposed at the subgrade and are allowed to dry out, the subgrade should be moisture conditioned prior to base placement (i.e., at or up to 2 % above the optimum moisture content as determined by ASTM D-698).
 - Foundations must be placed the same day they are excavated or covered with a mud mat.
 - Roof drains and surface drainage should not outlet or be directed to the ground surface within 25 feet of the proposed structure, unless the surface is impervious (such as concrete or pavement), to reduce moisture changes of the foundation soils.
 - The subgrade should be rough graded high to allow for removal of desiccated or saturated soil immediately prior to stone base placement.
 - Proper drainage should be provided around the proposed construction (e.g., slope the surface away from the building).
 - The floor slab subgrade should be sloped to drain. Where feasible, provide outlets for water that may collect in the gravel base for the floor slab.
 - Fill comprised of plastic clays should be placed at or up to 2 % above the optimum moisture content.
 - Unlined landscape areas and trees should not be placed adjacent to the building, since the vegetation tends to absorb excess water, resulting in shrinkage, especially during droughts.

6.6 KARST POTENTIAL

- Construction in karst areas presents risks that the owner must be willing to accept. The following measures can reduce these risks:
 - Evaluate and proofroll the subgrades prior to fill placement under the direction of an ECS representative.
 - Remediate disclosed karst features per recommendations provided by ECS during construction.
 - Foundations must be placed the same day they are excavated or covered with a mud mat.
 - Provide proper drainage around the proposed construction, including sloping the surface away from the buildings.

- Floor slab subgrades should be sloped to drain similar to the surface conditions.
 Provide outlets for water that may collect in the floor slab gravel base. This may include providing drainage mechanisms in building areas or installing weepholes in catchbasins in pavement areas.
- Roof drains should not discharge to the ground surface within 25 feet of proposed or existing structures, unless the surface is impervious (such as concrete or pavement).
- Provide drainage into storm sewers with granular utility bedding to reduce infiltration and ponding of water that tends to collect in granular backfill.

6.7 GROUNDWATER SEEPAGE

- The contractor should be prepared and experienced in handling groundwater conditions and should plan construction accordingly (e.g., including, but not limited to, not leaving excavations open and unprotected and laying back/shoring excavations as appropriate).
- Care should be taken not to allow fines to wash into sumps, since subsidence of the surrounding ground could occur. ECS should be contacted if silting of pumps or excessive groundwater seepage occurs.

6.8 STRUCTURAL FILL

Subgrade Requirements:

• Subgrade proofrolled and any required improvements completed.

Fill Material Requirements:

- No deleterious debris.
- No rock pieces larger than 3 inches.
- Less than 3% organic material (loss on ignition).
- Maximum dry density of at least 100 pcf according to the Standard Proctor compaction method (ASTM D-698), unless specifically approved otherwise by ECS.
- Acceptable Unified Soil Classifications (USCS): CL, CH (if approved by ECS for the intended use), ML, GW, GM, GC, GP, SW, SP, SM, SC.
- Unacceptable USCS classifications: CH (if not specifically approved by ECS for the intended use), OL, OH, Pt, MH.
- Evaluated and approved by ECS prior to construction.

Fill Placement Guidelines:

- Minimum compaction:
 - 98 % standard Proctor maximum dry density (ASTM D-698).
- Moisture Content:
 - Within 2 % of optimum (ASTM D-698) if plasticity index less than 30.
 - At or up to 3 % above optimum (ASTM D-698) if plasticity index greater than or equal to 30.
- Maximum loose lift thickness: 8 inches.

- Compaction test frequency:
 - One test per lift for each 5,000 square feet of fill placed.
 - Minimum of 3 tests per lift.
- Bench new fill into existing slopes or sidewalls in 1-foot steps or as approved by ECS at the time of construction.
- Compact and test each lift prior to placing additional lifts.
- Scarify smoothed fill surfaces prior to placing the next lift.
- Maintain positive surface drainage on fill surfaces during placement to preclude ponding of water.
- Roll fill surfaces smooth if rain is expected.
- Rough grade high to allow for removal of degraded surface soils if fill will be exposed to adverse weather conditions.
- Do not place fill on a frozen subgrade. At a minimum, remove frozen material, or allow to thaw and then recompact.

7.0 DESIGN RECOMMENDATIONS

7.1 FOUNDATIONS

General Comments:

- Conventional spread continuous wall and isolated column foundations should be suitable for support of the proposed building provided the plastic clay is addressed as recommended in Section 6.0.
- Bearing materials should consist of suitable stiff, undisturbed inorganic soils, Structural Fill.
- Foundation bearing conditions should be carefully evaluated by ECS during construction for the presence of unsuitable conditions.

Adjacent Structures:

- Plan new foundations to bear at the same level as the existing building foundations.
 Alternately, retention and/or underpinning of the existing foundations may be necessary.
- Design the additions to accommodate some differential settlement with respect to the existing building.
- A bond breaker should be placed between the new and existing foundations to avoid load transfer (unless this is the specific intent of the design and the construction has been designed to handle these stresses). Retention and/or underpinning of the existing foundations may be necessary if excavation below the existing foundation bearing level occurs.

| FOUNDATION DESIGN RECOMMENDATIONS | | | | | |
|---|--|--|--|--|--|
| DESIGN PARAMETER | CONTINUOUS WALL FOUNDATIONS | ISOLATED COLUMN FOUNDATIONS | | | |
| Net Allowable Bearing Pressure ⁽¹⁾ | 2,500 psf | 3,000 psf | | | |
| Acceptable Bearing Soil Material | Suitable stiff, undisturbed soils or Structural Fill | Suitable stiff, undisturbed soils or Structural Fill | | | |
| Minimum Width | 18 inches | 24 inches | | | |
| Depth of Foundations Subject to Freezing (below slab or finished grade) (2) | 30 inches | 30 inches | | | |
| Depth Foundations Protected from Freezing | 12 inches | 12 inches | | | |
| Estimated Total Settlement (4) | ≤ 1 inch | ≤1 inch | | | |
| Estimated Differential Settlement (4) | ≤¾ inch | ≤¾ inch | | | |

Notes:

- (1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
- (2) The 2018 Kentucky Building Code requires a minimum foundation embedment depth of 24 inches for foundations subject to freezing in Hardin County. However, a minimum embedment of 30 inches is common for commercial development in the project region.
- (3) The recommended net allowable bearing pressures may be increased 33 percent for transient loading.
- (4) The estimated settlement potential is based on the following: empirical guidelines for the project soil types and consistencies; the assumption that ECS will observe and test each foundation excavation during construction; and the provided project information. Actual settlements will depend, in part, on site preparation and conditions at each foundation location.

| SOIL PARAMETER FOR FOUNDATION LATERAL RESISTANCE | ESTIMATED VALUE ⁽¹⁾ |
|---|--------------------------------|
| Coefficient of At-Rest Earth Pressure (K _o) | 0.58 |
| Coefficient of Active Earth Pressure (K _a) | 0.41 |
| Coefficient of Passive Earth Pressure (Kp) | 2.46 |
| Unit Weight of Soil (γ) | 125 pcf |
| Base Shear Adhesion [Concrete on Undisturbed Clay] | 500 psf |
| Coefficient of Friction [Concrete on Clay] (μ) | 0.30 |

Notes:

- (1) These design parameters do not include factors of safety. Appropriate factors of safety should be included in all designs.
 - Desiccation or disturbance may result in soil voids or cracks adjacent to foundations, reducing passive and uplift resistance. As a result, for these calculations, the upper 2.5 feet of soils should be neglected for passive resistance.
 - Ignore passive earth pressure if the soil against the sides of the foundations may not be
 present during the life of the structure (e.g., the soil could be excavated or be subject to
 erosion).

Construction Guidelines:

- The bearing conditions of all foundations should be evaluated by ECS at the time of
 construction to confirm the presence of adequate bearing soils and to provide
 recommendations for the remediation of unsuitable soils, if present. This evaluation
 should be performed before any reinforcing steel is placed in the excavations.
- Concrete should be placed the same day the foundations are excavated to reduce degradation of the bearing surface due to exposure. Alternatively, a "mud mat" of lean concrete should be placed to protect the bearing surface.
- Disturbed, degraded or loose material should be removed from the excavation bottoms prior to concrete placement.

7.2 FLOOR SLABS

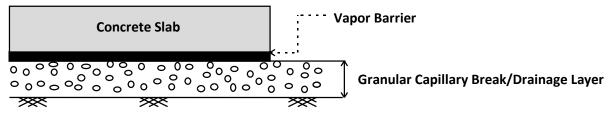
General Comments:

- If the risk associated with the existing fill is acceptable to the Owner, and the fill subgrade is evaluated by ECS at the time of construction, the existing uncontrolled fill may be left in-place below floors.
- If the risk associated with the existing fill is not acceptable to the Owner, the uncontrolled fill should be removed and replaced with Structural Fill or the floor should be designed as an elevated slab.

Slab Subgrade Recommendations:

- Recommended Slab Type: Grade supported floor slabs.
- Prepare subgrade in accordance with recommendations contained within this report.
- Subgrade proofrolled by an ECS representative and any required improvements completed.
- Subgrade modulus for slab design: 100 pci.
- Place a minimum of 4 inches of well-graded crushed stone or angular sand base.

- Compact base material in accordance with the Structural Fill recommendations provided previously.
 - Unless specifically approved otherwise, do not support floor slabs directly over opengraded coarse aggregate. If coarse aggregate is used as a drainage base, cap the coarse aggregate with a 2-inch (minimum) layer of well-graded aggregate.
- The following graphic depicts our soil-supported slab recommendations:



Compacted Subgrade

Notes:

- (1) Drainage layer should consist of a minimum of 4 inches of open-graded coarse gravel capped with a minimum 2-inch layer of coarse aggregate with fines (e.g., KYTC DGA).
- (2) Subgrade compacted to 98% maximum dry density per ASTM D698

Construction Guidelines:

- If a vapor barrier will be used, suitable concrete design mix, placement, finishing, and curing techniques should be employed to reduce the potential for differential slab shrinkage, cracking, and curling.
- Special care must be taken to prevent puncturing the vapor barrier during construction. We recommend utilizing the ACI 302 guidelines for placement of the vapor barrier, manufactured sand layer, and concrete as a function of the construction sequence.
- Drying shrinkage and concrete curing methods frequently causes floor slab cracks.
 Control joints and saw cuts should be installed in accordance with ACI guidelines to control cracking.
- Slab joints should be doweled or keyed to allow rotation of the slab sections without localized vertical displacement.
- Penetrations of the floor slab by fixed objects, such as drains or piping, restrict shrinkage movement and must be isolated to reduce cracking potential.
- Slab-on-grade floor should be structurally isolated from foundation supported walls.
- Backfill along foundation excavations should be carefully controlled to reduce differential slab settlement.

7.3 SEISMIC DESIGN CONSIDERATIONS

- Recommended Seismic Design Site Class: "C"
- Reference: 2018 Kentucky Building Code.
- The recommended site class was based on an analysis of site subsurface conditions using empirical relationships between in-situ or laboratory test results and material properties.

7.4 RETAINING WALLS

Design Assumptions:

- The backfill adjacent to the walls will consist of free-draining granular material or properly designed drainage composite boards installed.
- The walls will be fully drained.
- The construction guidelines given in this report will be utilized.
- No lateral pressures due to swelling of plastic clays or existing fill.

Construction Guidelines:

- A perforated pipe, wrapped in filter fabric, should be placed at the base of the granular backfill or drainage boards to enable removal of accumulated water. The pipe should be extended to daylight or a suitable sump pump system.
- A minimum 2-foot wide zone of granular backfill should be placed behind the wall. Filter
 fabric must be placed between the backfill and the existing ground surface if open-graded
 backfill, such as No. 57 stone, is used.
- The wall backfill should be placed in thin lifts and should be compacted with hand-guided compaction equipment to at least 95 percent of the standard Proctor maximum dry density of the material. Over-compaction (greater than 98 percent of the standard Proctor maximum dry density) should be avoided.
- Heavy equipment should not be permitted within 10 feet of the wall.
- Wall granular backfill should be capped with a minimum of 2 feet of compacted clay to reduce direct infiltration of surface water. A clay cap is not required where the backfill is overlain by a low infiltration surface (such as asphalt or concrete).

Design Recommendations:

- For the assumed design conditions, the design lateral earth pressure loads can be calculated using the following design parameters:
 - At-Rest Earth Pressure Coefficient: 0.58.
 - Active Earth Pressure Coefficient: 0.41.
 - Passive Earth Pressure Coefficient: 2.46.
 - Unit Weight of Soil: 125 pcf.
- The design sliding resistance should be calculated using the lowest value resulting from the following parameters:
 - Base Shear Adhesion (Concrete on Clay): 500 psf.
 - Coefficient of Friction (Concrete on Clay): 0.30.
- These design parameters do not include factors of safety. Appropriate factors of safety should be included in all designs.
- These values apply for a horizontal soil surface behind the walls. Contact ECS to provide appropriate values for sloping backfill or other special conditions.
- Additional loads due to construction phase or operational surcharges should be included in the wall design, if applicable.
- It may be feasible to partially resist surcharges or loading from retained structures through diaphragm action.

7.5 FLEXIBLE PAVEMENT DESIGN

Application:

• Main driving lanes, parking areas or other locations where heavy vehicle or other equipment will not turn on a tight radius or be parked for extended periods of time.

General Comments:

- The limitations and recommendations associated with low strength soils and plastic clays are described in more detail in **Sections 6.0** and should be carefully understood and incorporated into construction planning.
- The pavement sections below are guidelines that may or may not comply with local jurisdictional minimums.

| FLEXIBLE DESIGN PARAMETERS | | | | |
|---|----------------|--|--|--|
| DESIGN METHOD AASHTO Guide for Design of Pavement Structures (1993) | | | | |
| DAILY EQUIVALENT 18-KIP AXLE | 5 (Light Duty) | | | |
| LOADS 10 (Heavy Duty) | | | | |
| DESIGN LIFE | 20 Years | | | |
| CALIFORNIA BEARING RATIO | 3 (CBR) | | | |
| RELIABILITY | 80% | | | |
| TERMINAL SERVICEABILITY INDEX | 2.0 | | | |

| RECOMMENDED FLEXIBLE PAVEMENT SECTIONS (1) | | | | | |
|---|-----------|------------|-----------|--|--|
| PAVEMENT SECTION HOT MIX ASPHALT HOT MIX ASPHALT GRANULAR BASE WEARING SURFACE BINDER OR BASE KYDOT DGA | | | | | |
| Light Duty | 1½ inches | 1 ½ inches | 8 inches | | |
| Heavy Duty | 1½ inches | 1½ inches | 10 inches | | |

Notes:

Subgrade Requirements:

- Prepare subgrade in accordance with recommendations contained within this report.
- Proofroll under the direction of a ECS representative and complete required improvements.
- Pavement subgrades sloped to facilitate drainage.

Drainage Requirements:

- Permit water movement beneath curbs at the subgrade level.
- Design catch basins to include finger drains at the granular base level

Construction Guidelines

 Pavements should be constructed in accordance with the construction and material guidelines in the most recent edition of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction."

⁽¹⁾ It should be noted that although flexible pavement for the 20-year design period is structurally sound, an asphalt overlay is usually necessary after 7 to 12 years due to normal wear and exposure of the surfacing layer. In general, asphalt pavement should be sealed approximately 3 to 5 years to extend the life of the asphalt.

- Granular base should be compacted in accordance with the controlled fill recommendations provided in a previous section.
- In-place density, thickness, and gradation tests should be conducted by a ECS representative on the pavement components during construction to confirm compliance with project specifications.

7.6 RIDGID PAVEMENT DESIGN

Application:

Rigid pavements are suitable wherever flexible pavements can be used. Rigid pavements
often provide better service for dumpster aprons, entranceways, or other areas where
heavy trucks will turn on a tight radius or be parked for extended periods of time.

General Comments:

- The limitations and recommendations associated with low strength soils and plastic clays are described in more detail in **Sections 6.0** and should be carefully understood and incorporated into construction planning.
- The pavement sections below are guidelines that may or may not comply with local jurisdictional minimums.

| RIGID PAVEMENT DESIGN PARAMETERS | | | | | |
|----------------------------------|--|--|--|--|--|
| Design Method | ACI Guide for the Design and Construction of Concrete Parking Lo (ACI 330R-08) | | | | |
| Traffic Category | A (Light Duty): Car Parking, Access, and Interior Lanes | | | | |
| | B (Heavy Duty): Entrance, Exterior, and Service Lanes | | | | |
| Design Life | 20 Years | | | | |
| California Bearing Ratio | 3 (CBR) | | | | |
| Effective Subgrade Modulus | 100 pci | | | | |
| Concrete Modulus of Rupture | 500 psi | | | | |
| RELIABILITY | 80% | | | | |
| TERMINAL SERVICEABILITY INDEX | 2.0 | | | | |

| RECOMMENDED RIGID PAVEMENT SECTIONS | | | | |
|---|-------------------------|----------|--|--|
| PAVEMENT SECTION PORTLAND CEMENT CONCRETE GRANULAR BASE KYDOT DGA | | | | |
| Light Duty | 5 inches | 4 inches | | |
| Heavy Duty ⁽¹⁾ | 6 inches ⁽¹⁾ | 4 inches | | |

Notes:

(1) It should be noted that dumpster pads should have a minimum concrete thickness of 7 inches.

Subgrade Requirements:

- Prepare subgrade in accordance with recommendations contained within this report.
- Proofroll under the direction of a ECS representative and complete required improvements.
- Pavement subgrades sloped to facilitate drainage.

Drainage Requirements:

- Permit water movement beneath curbs at the subgrade level.
- Design catch basins to include finger drains at the granular base level.

Concrete Recommendations:

- 4,000 pounds per square inch (psi) minimum 28-day compressive strength.
- 4 to 6 percent entrained air.
- Proper joint spacing to control shrinkage cracking.
- Dowels at construction joints to properly transfer loads between pavement sections.
- Control joints where concrete pavement abuts fixed structures or protrusions.

8.0 CLOSING

There are certain limitations inherent to geotechnical explorations and reports. These limitations are discussed below and in the ASFE "Important Information About Your Geotechnical Engineering Report" in the Appendix. They should be fully considered prior to using the recommendations in this report.

Our geotechnical exploration identified the subsurface conditions that existed only at the locations and times that the borings were advanced. Given the natural variable characteristics of soil and rock, conditions may vary over short distances, change with time, or be affected by natural events, such as floods or earthquakes, or by human activity, such as past land use or new construction. As such, the information generated during our geotechnical exploration may not be representative of the entire conditions that may exist on the project site now or in the future. We use our professional judgment to render an opinion about the subsurface conditions that may exist in the areas of the site not specifically tested during our exploration based on our review of available field and laboratory data and our past experience with similar subsurface conditions. However, the subsurface conditions encountered during construction may vary from the assumed conditions. Variations in the subsurface conditions between our borings and in unexplored areas of the site could affect our interpretations. Thus, it is important to retain ECS to provide construction monitoring services based on our involvement in the project, our knowledge about the site, and our knowledge relating to the assumptions and recommendations contained within this report.

The recommendations contained within this report are dependent on many factors, including, but not limited to, the project information provided by others and the specific conditions encountered during our exploration. If the project information contained within this report is incorrect or changed at a later date or if the location or nature of the structures or facility components changes, ECS should be notified and given the chance to assess the impact of the changes. We cannot and do not accept responsibility or liability for problems that occur because we were not given the opportunity to properly assess changes to the project. The recommendations contained in this report must not be considered valid unless our firm reviews such changes and required modifications to our recommendations are verified in writing.

Our recommendations are dependent on several factors including, but not limited to, our review of project drawings and specifications prior to construction and observation of actual conditions during construction, including providing the required special inspections. We strongly recommend that ECS be retained to review pertinent portions of the project plans and specifications.

This report should be reproduced in its entirety only. Portions of this report should not be separated and used by others. It should be noted that this report was not prepared for the purpose of bid development and should not be used as such.

This geotechnical report is unique and was based on client needs and project requirements for the specific project described in this report. As such, no one other than who the report was intended and prepared for should rely on this report or the information contained within the report without first consulting with ECS. This report is not valid for any purpose or project except as described in this report.

This report and our recommendations were prepared using the generally accepted standards of geotechnical engineers practicing in this region. No other warranty is express or implied.

APPENDIX A – Drawings & Reports

Site Vicinity Plan Boring Location Plan





Site Vicinity Map ECTC - STUDENT CENTER RENOVATIONS

600 COLLEGE STREET ROAD ELIZABETHTOWN, KENTUCKY 42701

| ΞΝ | GI | N | Ε | Ε | R |
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SCALE 1"=1000'

PROJECT NO. 61:2331

SHEET 1 OF 1 DATE 6/12/2020

SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project coordination.

1.02 RELATED REQUIREMENTS

- A. General Conditions
- B. Special Conditions
- C. Section 016000 Product Requirements: General product requirements.
- D. Section 017000 Execution and Closeout Requirements: Additional coordination requirements.

1.03 PROJECT COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend upon each other for proper installation, connection and operation.
 - 1. Where installation of one part of the Work is dependent upon installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
 - 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

C. General Coordination Provisions:

- 1. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- 2. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- 3. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- 4. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- 5. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.
- 6. Recheck measurements and dimensions, before starting each installation.
- 7. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- 8. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED END OF SECTION

SECTION 014110 - STRUCTURAL SPECIAL INSPECTION & CONTRACTOR RESPONSIBILITY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. General Conditions of the Construction Contract Inspection of Work / Defective or Incomplete Work / Special Inspections shall apply in its entirety to this project. Where any conflict exists between this Specification Section and the General Conditions, the General Conditions provisions shall supersede in all aspects.

1.2 SUMMARY

- A. Special Inspections as defined in Section 1704 of The Kentucky Building Code are required.
- B. The Risk Category, Seismic Design Category, and Basic Wind Speed for the structure are shown in the General Notes section of the structural drawings.
- C. Special inspections per Kentucky Building Code Sections 1704 and 1705 are required for the following materials and work:
 - 1. Inspection of Fabricators per Section 1704.2.5 of the Kentucky Building Code.
 - 2. Steel Construction per Section 1705.2 of the Kentucky Building Code.
 - 3. Concrete Construction per Section 1705.3 of the Kentucky Building Code.
 - 4. Masonry Construction per Section 1705.4 of the Kentucky Building Code.
 - 5. Prepared Fill per Section 1705.6 of the Kentucky Building Code.
 - 6. Additional materials and work as/if indicated on the Construction Drawings.
- D. The special inspections required on this project are further defined in the Special Inspections section of the structural drawings.

1.3 SCOPE

- A. The scope of the construction work to be inspected / tested / observed is that structural and foundation work shown on the structural construction drawings (S- sheets) as well as the following:
 - 1. Geotechnical fill immediately below and within the footprint of the building shown on the structural drawings.
- B. All inspections and tests performed shall be documented by report including, but not limited to, inspections for grout and concrete placement, reinforcing inspection, curing, fabricators, deck attachment, etc.

1.4 DEFINITIONS

A. In accordance with the intent of the Building Code, inspection work specified to be "continuous" shall be inspected the full, uninterrupted time that the Contractor is performing said construction work. Work specified to be "periodic" may be inspected as convenient to the Inspector, except that all work must be inspected prior to being covered by other work, during the working hours of the Contractor, and in a fashion that does not delay the

Contractor. Regardless as to whether inspections are performed in "continuous" or "periodic" fashion, 100% of the construction work shall be inspected, unless noted otherwise.

1.5 SELECTION AND PAYMENT

- A. The Inspection Agency shall be retained by the Owner. Costs for reinspection and retesting, should discrepancies be found, will be paid for by the Owner, except where rework is due to negligence or omission deemed excessive by the Owner.
 - 1. In case of excessive rework, such retesting and reinspection shall be paid for by the Owner as an additional service of the Inspection Agency, but will be backcharged by deductive change order to the Contractor's contract.
 - 2. In case of excessive waste/lost time of the Special Inspector due to inadequate scheduling by the General Contractor, such time shall be paid for by the Owner as an additional service of the Inspection Agency but will be backcharged by deductive change order to the Contractor's contract.
- B. Special Inspections are additional to testing and inspection requirements shown elsewhere in the specifications and on the drawings, which is to be paid for by the Contractor. The Contractor shall also pay for additional structural testing and inspection required for their convenience. Inspection work not part of the Structural Special Inspections may be performed by an Inspection Agency of the Contractor's choosing, unless noted otherwise.

1.6 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Fabricator certificate of current good standing with Qualified Certification Program.
- C. Fabricators exempt from special inspection shall submit a *Certificate of Compliance* to the structural engineer of record at the completion of fabrication stating that all work was completed in accordance with the approved construction documents.

1.7 QUALITY ASSURANCE

- A. Qualified Certification Authorities: Subject to compliance with Kentucky Building Code Requirements, Qualified Certification Authorities providing certification which may be applicable to Project include:
 - 1. American Concrete Institute (ACI).
 - 2. American Institute of Steel Construction (AISC).
 - 3. American Society of Nondestructive Testing (ASNT).
 - 4. American Welding Society (AWS).
 - 5. Cold Formed Steel Engineers Institute (CFSEI).
 - 6. International Accreditation Service (IAS).
 - 7. International Code Council (ICC).
 - 8. National Institute of Certified Engineering Technology (NICET).

PART 2 - EXECUTION

2.1 PROGRESS MEETINGS

- A. The Special Inspector's designated Project Manager is to attend any pre-construction meetings which may be conducted at the construction site by the Structural Engineer to discuss quality issues.
- B. The Special Inspector's designated Project Manager is to attend construction progress meetings which will be held at the construction site by the Architect, Engineer, and General Contractor.

2.2 CONTRACTOR'S RESPONSIBILITIES

- A. Provide a complete copy all structural shop drawings to the Structural Testing/Inspection Agency.
- B. Arrange the preconstruction meeting to discuss quality issues.
- C. Notify the Structural Testing/Inspection Agency sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
- D. Cooperate with Structural Testing/Inspection Agency and provide access, including equipment with operator, to work. Access equipment includes, but is not limited to, man lifts, excavation equipment, etc.
- E. Provide samples of materials to be tested in required quantities.
- F. Provide storage space for Structural Testing/Inspection Agency's exclusive use, such as for storing and curing concrete testing samples. If required by Special Inspector, General Contractor shall provide cure box with electricity, water, and blankets for curing concrete specimens.
- G. Provide labor to assist the Structural Testing/Inspection Agency in performing tests/inspections. Labor includes, but is not limited to, construction of masonry prisms, etc.
- H. Construction and work for which Special Inspection is required shall remain accessible and exposed for special inspection purposes until the completion of the inspections and tests.
- I. All parties who are to receive inspection and testing reports shall maintain an active email account to receive reports by.
- J. General Contractor shall create and maintain a discrepancy log on site. Log shall list each discrepancy documented by the Special Inspector; state the date of discovery and Special Inspector's report number; and provide room for the Special Inspector to sign and date when said discrepancy is corrected. No work containing discrepancy shall be covered prior to having reinspection and approval by the Special Inspector.
- K. Neither the observation of the Architect/Structural Engineer in the administration of the contract, nor tests/inspections by the Testing/Inspection Agency, nor approvals by any other person(s) shall relieve the Contractor from their obligation to perform the work in accordance with the Contract Documents.

2.3 SPECIAL INSPECTOR'S RESPONSIBILITIES

- A. Cooperate with the Contractor and provide timely service.
- B. Notify Contractor of minimum advance notice for each type of inspection/test.

- C. Upon arriving at the construction site, sign in and notify the Contractor of presence.
- D. Select the representative samples that are to be tested/inspected.
- E. Perform tests/inspections as outlined in the Contract Documents, the applicable codes, and as directed by the Structural Engineer.
- F. Keep records of all inspections.
- G. Furnish inspection reports to the Architect, Structural Engineer, and General Contractor weekly as construction progresses.
 - 1. Each report shall include photographs of the project status and the typical work inspected and documented in that subject report. These general photographs are in addition to the required photograph at discrepancies.
- H. Inform General Contractor and / or Fabricator of all discrepancies immediately for correction.
 - 1. Document in writing correction of discrepancies.
 - 2. Highlight discrepancies within the report.
 - a. The report shall include a text description of each discrepancy. Description shall convey the discrepancy location on the project and the issue.
 - b. The report shall include a photograph of each discrepancy observed in the field and/or in the shop. Photograph shall be labeled to convey location on project and the issue shown. (Photographs of material strength tests for concrete and/or masonry are not required, unless otherwise instructed.)
 - c. The report shall document the date that each discrepancy was initially discovered.
 - Inspection related discrepancies shall be reinspected by the Special Inspector along the course of the project and prior to concealment by other work.
 Subsequent reports shall document date that prior discrepancy was confirmed to be corrected.
 - 3. If discrepancies are not corrected, the discrepancies shall be brought to the attention of the Code Official and the Structural Engineer prior to the completion of that phase of the work.
- I. Leave copies of field notes with the Contractor prior to leaving the construction site. Field notes shall include the message given to the Contractor, date, time of message, name of Contractor's representative informed, type and location of work or materials tested/inspected, whether the work or materials complies with Contract Documents and name of the Structural Testing/Inspection Agency's representative.
- J. Immediately notify General Contractor, Architect, and Structural Engineer by separate letter if work yet to be inspected is found on site that is either being covered by other work or was to receive continuous inspection.
- K. Structural Testing/Inspection Agency shall not alter requirements of Contract Documents, approve or reject any portion of the work, or perform duties of the Contractor.
- L. Submit a final report of inspections documenting completion of **all** required Special Inspections and correction of any discrepancies noted in inspections to the Structural Engineer. Final report shall be prepared by, sealed, and signed by the Special Inspector

and shall include a complete list of materials and work inspected during the course of the project. One copy of said report is to be provided to the Contractor for their records.

END OF SECTION 014110

SECTION 015713 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 311000 Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 312200 Grading: Temporary and permanent grade changes for erosion control.
- C. Section 321123 Aggregate Base Courses: Temporary and permanent roadways.
- D. Section 329219 Seeding: Permanent turf for erosion control.
- E. Section 329223 Sodding: Permanent turf for erosion control.

1.03 REFERENCE STANDARDS

- A. ASTM D4355/D4355M Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus; 2014.
- B. ASTM D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2014).
- C. ASTM D4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.
- D. ASTM D4632/D4632M Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
- E. ASTM D4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.
- F. ASTM D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002 (Reapproved 2009).
- G. EPA (NPDES) National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- H. FHWA FLP-94-005 Best Management Practices for Erosion and Sediment Control; 1995.
- USDA TR-55 Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2009.

1.04 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Also comply with all more stringent requirements of State of Kentucky Erosion and Sedimentation Control Manual.
- C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
 - 2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Erosion and Sedimentation Control Plan:

- 1. Submit within 2 weeks after Notice to Proceed.
- 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - Format required by law is acceptable, provided any additional information specified is also included.
- 3. Obtain the approval of the Plan by authorities having jurisdiction.
- 4. Obtain the approval of the Plan by Owner.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- E. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures used during construction and temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mulch: Use one of the following:
 - 1. Straw. Do not use hay.
 - 2. Wood waste, chips, or bark.
 - 3. Erosion control matting or netting.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 - 1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 - 2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491.
 - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 - 4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 - 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 - 6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533.
 - 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
 - 8. Manufacturers: subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. TenCate: www.tencate.com/#sle.

- b. North American Green: www.nagreen.com/#sle.
- c. Propex Geosynthetics: www.geotextile.com/#sle.
- D. Silt Fence Posts: One of the following, minimum 5 feet long:
 - 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 - 2. Hardwood, 2 by 2 inches in cross section.
- E. Gravel: See Section 321123 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 - 1. Width: As required; 20 feet, minimum.
 - 2. Length: 50 feet, minimum.
 - 3. Provide at each construction entrance from public right-of-way.
 - 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
 - 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
 - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
 - e. Across the entrances to culverts that receive runoff from disturbed areas.
 - 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- E. Crushed Stone Silt Checks: Stone check dams located along drainage swales and above headwalls. Silt checks are to be installed as required to reduce the sediment load of the runoff to local, State and Federal requirements. Construction is to be in accordance with the contract documents and KTC requirements.
- F. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.

- 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw; do not use hay.
- G. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
 - 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
- H. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
 - 1. Excavate minimum of 6 inches.
 - 2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
 - 3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.

B. Silt Fences:

- 1. Store and handle fabric in accordance with ASTM D4873.
- 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
- 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
- 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
- 5. Install with top of fabric at nominal height and embedment as specified.
- 6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
- 7. Fasten fabric to wood posts using one of the following:
 - a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gage, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gage, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
- 8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
- 9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.

C. Mulching Over Large Areas:

- 1. Dry Straw: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
- 2. Wood Waste: Apply 6 to 9 tons per acre.
- 3. Erosion Control Matting: Comply with manufacturer's instructions.
- D. Mulching Over Small and Medium Areas:
 - 1. Dry Straw: Apply 4 to 6 inches depth.
 - 2. Wood Waste: Apply 2 to 3inches depth.
 - 3. Erosion Control Matting: Comply with manufacturer's instructions.

E. Temporary Seeding:

- 1. When hydraulic seeder is used, seedbed preparation is not required.
- 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
- 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.

- 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
- 5. Incorporate fertilizer into soil before seeding.
- 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
- 7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
- 8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 - 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 - 2. Remove silt deposits that exceed one-third of the height of the fence.
 - 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Stone Silt Checks: Remove accumulated sediment when it reaches 1/3 of the height of the check.
- E. Clean out temporary sediment control structures weekly and relocate soil on site.
- F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- D. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- E. Product Selection Procedures: Procedures for product selection include the following:
 - 1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
 - 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - 3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - 4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - 5. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed.
 - 6. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specific product or system indicated.
 - 7. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.

- 8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 EXECUTION

3.01 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.
- I. If any material or piece of equipment is damaged during transportation and handling, the Owner has the right to reject this material or equipment and require a new, undamaged replacement.

3.02 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- K. If any material or piece of equipment is damaged during storage or after installation but before occupancy, the Owner has the right to reject this material or equipment and require a new, undamaged replacement.

END OF SECTION

SECTION 017000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Verify locations of survey control points prior to starting work. Contractor shall locate and protect survey control and reference points.
- C. Protect site from puddling or running water.
- D. Perform dewatering activities, as required, for the duration of the project.
- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.04 PROGRESS CLEANING

- Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.05 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

END OF SECTION

SECTION 017300 - CUTTING AND PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.03 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.04 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas..

3.03 PATCHING AND REPAIRS

- A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.
- B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.
- C. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.
- D. Patch and repair floor and wall surfaces in the new space where demolished walls or partitions extend from one finished area into another. Provide a flush and even surface of uniform color and appearance.
 - 1. Closely match texture and finish of existing adjacent surface.
 - 2. Patch with durable seams that are as invisible as possible. Comply with tolerances.
 - 3. Where patching smooth painted surfaces, extend final paint coat over entire unbroken surface containing the patch after the surface has received primer and second coat.
 - 4. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 5. Inspect and test patched areas to demonstrate integrity of the installation, where feasible.
- E. Existing penetrations and openings due to the removal of existing communications, data, life safety, electrical, HVAC, sprinkler, or plumbing systems are to be filled and patched as follows:
 - 1. Above New Ceiling Heights:
 - a. Existing through-wall penetrations above new ceiling height 4" diameter/square or less, patch with solid, permanent fill material flush with adjacent wall surface.
 - b. Existing through-wall penetrations above new ceiling height from 4" diameter/square to approximately 1'-0" x 1'-0" diameter/square. Fill opening with

- sound attenuation blankets and attach 5/8" gypsum board to both sides of the adjacent wall surface to close opening.
- c. Existing through-wall penetrations above new ceiling height 1'-0" x 1'-0" diameter/square or larger in an existing framed wall. Frame opening with metal studs @ 12" on center. Fill space between studs with sound attenuation blankets and attach 5/8" gypsum board to both sides of the adjacent wall surface to close opening.
- d. Existing penetrations located above new ceiling height 1'-0" x 1'-0" diameter/square or larger in an existing CMU, or structural clay tile wall. Infill existing opening with CMU. Toothing into existing bond pattern is not required at above ceiling locations.
- 2. Below New Ceiling Heights:
 - a. Existing through-wall penetrations below new ceiling height 4" diameter/square or less. Patch with solid, permanent fill material. New plaster finish to match existing plaster surface texture, if applicable.
 - b. Existing through-wall penetrations below new ceiling height 4" diameter/square to approximately 1'-0" x 1'-0" diameter/square. Fill opening with sound attenuation blankets and inset 5/8" gypsum board on both sides of the wall to close opening. New plaster finish to match existing plaster surface texture, if applicable.
 - c. Existing through-wall penetrations below new ceiling height 1'-0" x 1'-0" diameter/square or larger in an existing framed wall. Frame opening with metal studs @ 12" on center. Fill space between studs with sound attenuation blankets and attach 5/8" gypsum board to both sides of the adjacent wall surface to close opening. New plaster finish to match existing plaster surface texture, if applicable.
 - d. Existing through-wall penetrations located below new ceiling height 1'-0" x 1'-0" diameter/square or larger in an existing CMU or structural clay tile wall. Infill existing opening with CMU, or structural clay tile set back from the existing wall surface to allow new plaster finish to be installed in specified thickness and to match existing surface texture, if applicable.
 - e. Existing through-wall penetrations located below new ceiling height 1 inch diameter/square or larger in walls with exposed CMU, or glazed structural tile units. Infill existing opening with CMU, or glazed structural tile unit, to match existing surface texture and bond pattern. Remove whole masonry unit(s) and tooth-in to match existing bond pattern.
 - f. Existing through-wall penetrations in rated wall assemblies to receive fire rated gypsum board, fire blankets and fire resistant caulk at the intersection of the existing wall and fire rated gypsum or rated CMU wall construction. Provide new plaster finish to match existing plaster surface texture if applicable.
- 3. Partial Wall Openings/Non-Through-Wall Penetrations Below New Ceiling Heights:
 - a. Wall openings left behind after demolition of fully or partially recessed electrical panels and other electrical items, communications, data, life safety, HVAC, sprinkler, or plumbing are to receive infill materials to match the surface of the wall.
 - Existing CMU/Glazed Structural Clay Tile Walls: Toothing into existing CMU, or glazed structural tile, matching bond pattern is required at below ceiling locations.
 - (a) Tooth-in with whole units.
 - 2) Existing Framed Walls: Frame opening with metal studs @ 12" on center. Fill space between studs with sound attenuation blankets and attach 5/8" gypsum board to exposed side of the adjacent wall surface to close opening.
 - b. Set back infill material as necessary to provide new plaster finish to match existing plaster surface texture if applicable.

3.04 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

- 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
- Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

END OF SECTION

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Owner's Project Requirements and Systems Basis of Design documentation are included by reference.
- C. Commissioning Plan and Appendices.

1.02 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Section 019113.13 Functional Testing
 - 2. Section 019331-01000 DECA Special Conditions
 - 3. Section 220800 Commissioning of Plumbing System
 - Section 230800 Commissioning of HVAC System
 Section 260800 Commissioning of Electrical System
- C. Systems Commissioned
 - 1. Plumbing System
 - 2. HVAC System
 - 3. Electrical System

1.03 DEFINITIONS

- A. Commissioning (Cx): A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.
 - 1. ASHRAE. 2013. ASHRAE Guideline 0 The Commissioning Process. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.
- B. Commissioning Provider (CxP): The designated person, company, agent, or combination thereof identified by the Owner. This entity will lead, plan, schedule, and coordinate the Commissioning Team in implementing the overall Commissioning Process.
 - 1. ASHRAE. 2013. ASHRAE Guideline 0 The Commissioning Process. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.
- C. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process. It includes a schedule of Commissioning Process activities, individual responsibilities, documentation requirements, communication and reporting protocols, and evaluation procedures. This document is updated throughout the project.

- ASHRAE. 2013. ASHRAE Guideline 0 The Commissioning Process. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.
- D. Functional Test (FT): A written protocol that defines methods, personnel, and specifications for test conducted on components, equipment, assemblies, systems, and interfaces among systems.
 - ASHRAE. 2013. ASHRAE Guideline 0 The Commissioning Process. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.
- E. Owner's Project Requirements (OPR). A written document that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is updated throughout the project.
 - ASHRAE. 2013. ASHRAE Guideline 0 The Commissioning Process. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.
- F. Construction Checklist (CC): A form used by the Contractor to verify that appropriate components are on-site, ready for installation, correctly installed, and functional. Checklists also include manufacturer's installation start-up and checkout data. The Contractor is responsible for incorporating manufacturer's information into the preliminary checklists provided by the Commissioning Provider.
 - ASHRAE. 2013. ASHRAE Guideline 0 The Commissioning Process. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.
- G. Systems Basis of Design (SBoD): A document that identifies the design parameters of a project and how each criterion in the Owner's Project Requirements will be addressed. The document records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process. This document is updated throughout the project.
 - 1. ASHRAE. 2013. ASHRAE Guideline 0 The Commissioning Process. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA.
- H. Systems, Subsystems, Equipment, Assemblies and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.04 COMMISSIONING TEAM

- A. During the Construction Phase, members of the Commissioning Team consist of the Owner, Commissioning Provider, Project Manager, Contractor, members appointed by Contractor(s), Architect / Engineer, TAB Representative, Controls Contractor, and Commissioned System and Assembly Subcontractors, other installing subcontractors or suppliers of equipment, and Members Appointed by Owner(s).
- B. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. These members shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the Commissioning Provider.
- C. Members Appointed by Owner(s): Representatives of the facility user and operation and maintenance personnel.
- D. The Commissioning Provider is under contract with the Owner for this project.

1.05 OWNER'S RESPONSIBILITIES

- A. Provide the Owner's Project Requirements criteria to the Commissioning Provider for distribution to the Contractor.
- B. Approve the Systems Basis of Design documentation prepared by Architect / Engineer. Send notice of developing the Construction Checklists and Functional Performance Tests.

- C. Participate in Commissioning Process Meetings.
- D. Assign operation and maintenance personnel and schedule them to participate in Functional Testing activities.

1.06 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - 1. Attend Construction Phase Commissioning Conference.
 - 2. Satisfy applicable project Owner's Project Requirements.
 - 3. Review the Commissioning Plan prepared by Commissioning Provider.
 - 4. Cooperate with the Commissioning Provider for resolution of issues recorded in the Issues Tracking Log. Responses are anticipated one week of finding and notification.
 - 5. Attend Commissioning Team Meetings.
 - 6. Integrate and Coordinate commissioning process activities into Construction Schedule.
 - 7. Review, accept, and support execution of Construction Checklists provided by the Commissioning Provider.
 - 8. Support Functional Test Procedures, including seasonal and any deferred test procedures.
 - 9. Provide O&M Manuals and Close-Out Documents as required by the Project.
 - 10. Provide access to electrical, water, scaffolding, man-lifts, of other mechanical conveyances used by the contractors to perform their work during functional and performance testing under the direction of the CxP. If mechanical conveyances are unavailable during the commissioning process, the General Contractor will provide the necessary equipment for access required.
 - 11. For descriptions of these responsibilities reference the Commissioning Plan and Related Sections.

1.07 COMMISSIONING PROVIDER'S RESPONSIBILITIES

- A. Review the Owner's Project Requirements and Systems Basis of Design.
- B. Organize and lead the Commissioning Team.
- C. Provide Commissioning Plan.
- D. Convene Commissioning Team Meetings.
- E. Review submittals for commissioned equipment and assemblies.
- F. Provide Project specific Construction Checklists and Functional Test Procedures.
- G. Verify the execution of commissioning process activities. Verification will include, but is not limited to, equipment and component submittals, Construction Checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the Owner's Project Requirements. When there is a deviation from the standard, the Commissioning Provider will report the occurrence in the Issues Tracking Log.
- H. Prepare and maintain the Issues Tracking Log.
- I. Prepare and maintain a log of completed Construction Checklists.
- J. Collect data and review installation of systems, equipment, and component for Construction Checklists.
- K. Direct Functional Testing of systems, equipment, and components per Commissioning Plan.
- L. Compile test data, inspection reports, and certificates; include them in the Commissioning Report.
- M. Verify Owner Training for commissioned systems and assemblies.

N. Review commissioned systems operation during Warranty Period.

1.08 SCHEDULING

- A. Contractor shall integrate and coordinate commissioning process activities with Construction Schedule.
- B. All activities relative to commissioning shall be completed by Substantial Completion.
- C. Functional Test Procedures may require scheduling of seasonal and deferred functional testing to be performed after the building acceptance period. The Contractor shall be responsible for coordinating seasonal and any deferred functional testing activities with the Commissioning Team.
 - 1. Seasonal functional tests may be deferred to the appropriate weather conditions. Anticipated seasonal functional tests are identified in Specification Sections 019113.13– Functional Testing.
- D. Owner Training Schedules shall be as described in Section 017900 Demonstration and Training.

PART 2 - PRODUCTS [NOT USED]

PART 3 - EXECUTION

3.01 CONSTRUCTION CHECKLIST CREATION

- A. Construction Checklists consist of Paladin created draft checklists, manufacturer installation, start-up, and checkout data, and important instructional data and procedures not covered in manufacturer field checkout sheets.
- B. The Contract Documents and Commissioning Plan contain Construction Checklist information, sampling rates, and examples of Paladin's Construction Checklists. When the GC is ready to review the Construction Checklists, Paladin will distribute entire Construction Checklist package.
- C. The following process will be used for this project to develop and approve the Construction Checklists.
 - These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. There may be redundancy between checklist procedures and typical factory field checkout sheets. Double documentation is required in those cases.
 - 2. The CxP transmits draft Construction Checklists to the GC who then transmits the draft Construction Checklist(s) to the responsible Subcontractors for review and comment.
 - 3. The Subcontractor returns any comments on Construction Checklists to the CxP, through the GC.
 - 4. The CxP reviews Construction Checklist comments and incorporates changes as appropriate prior to use.

3.02 EXECUTION OF CONSTRUCTION CHECKLISTS

- A. The MEP Construction Checklists will be completed by the CxP according to the Sampling Strategy for CxP Observation of Construction Checklists contained in the Commissioning Plan.
- B. Four (4) weeks prior to startup, the Subcontractors and vendors schedule startup and initial checkout with the General Contractor and CxP.
- C. MEP Construction Checklists must be complete for each piece of equipment prior to any manufacturer or Sub start-up.
- D. As deficiencies are identified by the CxP, they will be documented in an Issues Tracking Log. Please see the Commissioning Plan for procedures related to issues tracking and closeout.

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3.03 FUNCTIONAL TESTING

A. Functional Testing Plan and Functional Testing requirements are in Specification Sections 019113.13. The CxP will prepare and finalize the tests with information such as: change orders, updated points list, control sequences and setpoints, input from contractors, and input from the A/E.

END OF SECTION 019113

SAMPLE CONSTRUCTION CHECKLIST

AIR HANDLING UNIT

| PROJECT: | | | DATE: |
|---|--|------------------------------|--|
| ENG. FILE NO: | _ | | |
| EQUIPMENT | | | |
| LOCATION: | | | |
| EQUIPMENT TAG: | AHU- | R | LOOM #: |
| AREA(S) SERVED: | | | |
| COMPONENTS | | | |
| INCLUDE: | Supply Fan | Return Fan | |
| VFDs | Economizer | Pre-Filters | |
| Cooling Coil | Heating Coil | Humidifier | |
| Air Blender | Final Filters | Duct Conne | ections |
| The checklist items | ove equipment and systems in are complete and have been ruction Checklist is submitted | checked off only by parties | e and ready for functional testing. s having direct knowledge of the attached list of outstanding items |
| 2. Party completing thi | s form and witnessing testing | : | |
| 3. Approvals. This c exceptions noted bel | | tlist has been reviewed. Its | completion is approved with the |
| Commissioning Pr | ovider Date | Owner's Represe | ntative Date |

ASSOCIATED CHECKLISTS

The listed Associated Checklists reference equipment and systems that interface with this equipment. These Associated Checklists may be of assistance in completing this Construction Checklist.

| ASSOCIATED CHECKLISTS | | | | | | |
|-----------------------|--|--------------------------|--|----------------------------|--|--|
| Constant-Speed Pumps | | Variable Frequency Drive | | Facility Management System | | |
| Steam Traps | | | | | | |
| Comments: | | | | | | |
| | | | | | | |

DOCUMENTATION REQUIREMENTS

| Requested documentation submitted | Rec'd |
|--|-------|
| Manufacturer's cut sheets | |
| Performance data | |
| Installation and startup manual and plan | |
| O&M manuals | |
| Factory test results | |
| Sequences and control strategies | |
| Warranty certificate | |
| Comments: | |

MODEL VERIFICATION

| AHU INFORMATION | | | | | |
|-----------------|--------------------|--|--|--|--|
| AHU Tag | AHU Location | | | | |
| System | Service Area | | | | |
| Manufacturer | Capacity (Cooling) | | | | |
| Model Number | Volts/Phase Rating | | | | |
| Serial Number | CFM | | | | |
| Comments: | | | | | |

| CABINET AND GENERAL INSTALLATION | | | | |
|--|--------------|-----------|--|--|
| Check if Acceptable; Provide comment if unacceptable | Field Note # | Reference | | |

| 1. Cabinet and general installation. | |
|---|----------|
| 2. Permanent labels affixed, including for fans. | |
| 3. Casing condition good: no dents, leaks, door gaskets installed. | |
| 4. Access doors close tightly - no leaks. | |
| 5. Connection between duct and unit tight and in good condition. | |
| 6. Vibration isolation equipment installed, and shipping blocks removed. | |
| 7. Maintenance access acceptable for unit and components. | |
| 8. Perforated liner installed in correct locations, in accordance with specs. | |
| 9. Thermal insulation properly installed and according to specification. | |
| 10. Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.). | |
| 11. Clean up of equipment completed per contract documents. | |
| 12. Air blenders and diffuser plate installed in proper location and blades not damaged or bent. | |
| 13. Filters installed, and replacement type and efficiency permanently affixed to housing. DP Indicators Installed. | |
| Comments: | |
| | |
| DDE HEAT VALVE DIDING | AND COH |
| PRE-HEAT VALVE, PIPING, A | AND COIL |
| Pipe fittings complete and pipes properly supported. | |
| 2. Pipes properly labeled. | |
| 3. Pipes properly insulated. | |
| 4. Strainers in place and clean, blowdown installed. | |
| 5. Piping system properly flushed. | |
| 6. No leaking apparent around fittings. | |
| 7. All coils are clean, and fins are in good condition. | |
| 8. Valve properly labeled. | |
| 9. Valve installed in proper direction. | |
| 10. Hot water supply and Return temperature instrumentation properly installed and located. | |

| 11. Test plugs (P/T), air vents, drain and isolation valves installed per drawings. | | | |
|---|--------|---------|--|
| Comments: | • | | |
| CHILLED WATER VALVE, PIPIN | IG, AN | ID COIL | |
| Pipe fittings complete and pipes properly supported. | | | |
| 2. Pipes properly labeled. | | | |
| 3. Pipes properly insulated. | | | |
| 4. Strainers in place and clean, blowdown installed. | | | |
| 5. Piping system properly flushed. | | | |
| 6. No leaking apparent around fittings. | | | |
| 7. All coils are clean, and fins are in good condition. | | | |
| 8. All condensate drain pans clean and slope to drain, traps installed per spec. | | | |
| 9. Valves properly labeled. | | | |
| 10. Valves installed in proper direction. | | | |
| 11. Chilled water supply and Return temperature instrumentation properly installed and located. | | | |
| 12. Test plugs (P/T), air vents, drain and isolation valves installed per drawings. | | | |
| Comments: | | I | |
| | | | |
| SUPPLY FAN | | | |
| 1. Fan and motor alignment correct. | | | |
| 2. Fan belt tension and condition good. | | | |
| 3. Fan protective shrouds for belts in place and secure. | | | |
| 4. Fan area clean. | | | |
| 5. Fan and motor properly lubricated. | | | |
| Comments: | | | |
| RETURN FAN | | | |
| 1. Fan and motor alignment correct. | | | |
| 2. Fan belt tension and condition good. | | | |
| 3. Fan protective shrouds for belts in place and secure. | | | |

| 4. Fan area clean. | |
|--|----|
| 5. Fan and motor properly lubricated. | |
| Comments: | |
| PRE-FILTERS | |
| 1. Filters installed and efficiencies match schedule. | |
| 2. Filters clean and tight fitting to filter frame. | |
| 3. Filter pressure differential measuring device installed and functional. | |
| 4. Access doors seal and close tightly. | |
| Comments: | |
| FINAL-FILTERS | |
| 1. Filters installed and efficiencies match schedule. | |
| 2. Filters clean and tight fitting to filter frame. | |
| 3. Filter pressure differential measuring device installed and functional. | |
| 4. Access doors seal and close tightly. | |
| Comments: | |
| DUCT CONNECTION | NS |
| 1. Sound attenuators installed. | |
| 2. Duct joint sealant properly installed. | |
| 3. No apparent severe duct restrictions. | |
| 4. Turning vanes in square elbows as per drawings. | |
| 5. OSA intakes located away from pollutant sources & exhaust outlets. | |
| 6. Pressure leakage tests completed. | |
| 7. Branch duct control dampers operable. | |
| 8. Ducts cleaned as per specifications. | |
| 9. Balancing dampers installed as per drawings and TAB's site visit. | |
| 10. Smoke and fire dampers installed properly per contract docs (proper location, access doors, appropriate ratings verified). | |
| Comments: | |
| ECONOMIZER | |

| 1. Return Air, Relief Air, and Outside Air Dampers and actuators are installed and operate freely. | | | |
|--|------|---|---|
| 2. Dampers seal tightly when closed and do not allow bypass air. | | | |
| 3. Actuators are secure, and linkages are tight. | | | |
| 4. All control and power wiring to actuators are complete. | | | |
| 5. Actuators are labeled and match control system labels. | | | |
| Comments: | | 1 | ı |
| ELECTRICAL AND CONT | ROLS | 5 | |
| 1. Power disconnects located within site of the unit it controls and labeled. | | | |
| 2. All electric connections tight. | | | |
| 3. Grounding installed for components and unit. | | | |
| 4. Safeties installed and operational. | | | |
| 5. Starter overload breakers installed and correct size | | | |
| 6. All control devices and wiring complete. | | | |
| 7. Control system interlocks connected and functional. | | | |
| 8. Smoke detectors in place and wiring complete. | | | |
| Comments: | • | | |
| SUPPLY FAN VFD | | | |
| 1. Drive location not subject to excessive temperatures, moisture, or dirt | | | |
| 2. Drive size matches motor size. | | | |
| 3. Permanent label affixed, and UL stamp approved. | | | |
| 4. VFD interlocked to control system. | | | |
| 5. Operation checked in HAND, OFF, and AUTO. As applicable operation also checked in BYPASS. | | | |
| 6. Where applicable, ensure safeties are active in all modes. | | | |
| 7. VFD powered (wired to controlled equipment). | | | |
| 8. VFD Checklist completed (see 23.02) | | | |
| Comments: | | · | |
| RETURN FAN VFD | | | |
| 1. Drive location not subject to excessive temperatures, moisture, or dirt | | | |

| 2. Drive size matches motor size. | |
|--|----|
| 3. Permanent label affixed, and UL stamp approved. | |
| 4. VFD interlocked to control system. | |
| 5. Operation checked in HAND, OFF, and AUTO. As applicable operation also checked in BYPASS. | |
| 6. Where applicable, ensure safeties are active in all modes. | |
| 7. VFD powered (wired to controlled equipment). | |
| 8. VFD Checklist completed (see 23.02) | |
| Comments: | |
| | |
| SENSORS AND GAGI | ES |
| 1. Temperature, pressure, and flow gages and sensors installed. | |
| 2. Piping gages, BMS, and associated panel temperature and pressure readouts match. | |
| Comments: | |
| TAB | |
| 1. TAB data has been spot checked. | |
| Comments: | |

MANUFACTURER'S INSTALLATION INSTRUCTIONS

| (Link to file.) | | | | | |
|--|----------------|--------------|---|-------------------|-----------|
| OPERATIONAL CHECK TEAM | | | | | |
| Name | Date | Name | | | Date |
| These augment manu | OPERATIO | | | nctional Testing. | |
| Check if Acceptable; Provide com | ment if una | cceptable | | Field Note # | Reference |
| 1. Supply fan rotation correct (If VFD, chee and VFD Inverter mode). | ck rotation in | n bypass | | | |
| 2. Fans exhibit no unusual noise or vibratio | n. | | | | |
| 3. Inlet damper aligned in housing, actuator smoothly and on input signal from EMS. | r spanned, clo | oses | | | |
| 4. All dampers (OSA, RA, EA, etc.) stroke and spans calibrated and BMS reading site ve | • | t binding | | | |
| 5. Valves stroke fully and easily and spann | ing is calibra | ted. | | | |
| 6. Valves verified to not be leaking through | coils, humic | difier, etc. | П | | |

SENSOR AND ACTUATOR CALIBRATION

when closed at normal operating pressure.

documentation record submitted for this system.

8. Condensate Traps are operating properly.

Steam Traps are operating properly.

Comments:

Specified point-to-point checks have been completed and

Vapor Trail being absorbed within available distance.

The following field-installed temperature, relative humidity, CO, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment were calibration checked.

| Sensor or Actuator & Location | Location OK | 1st Gage or BMS Value | Instr. Measured Value | Final Gage or BMS Value | Pass? |
|----------------------------------|----------------|--------------------------|-----------------------------|----------------------------|-------|
| | | | | | |

Gage reading = reading of the permanent gage on the equipment.

FMS = Facility Management System

Instr. = Testing instrument

Visual = Actual observation

The Contractor's own sensor check-out sheets may be used in lieu of the above, if the same recording fields are included and the referenced procedures are followed.

INSTRUMENTATION REFERENCES

(Link to file.)

FIELD NOTES

| Note # | Equip Tag | Corrected | Issue |
|--------|-----------|-----------|-------|
| | | | |
| | | | |

END SAMPLE HVAC EQUIPMENT CONSTRUCTION CHECKLIST

SECTION 019113.13 - FUNCTIONAL TESTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Owner's Project Requirements and Systems Basis of Design documentation are included by reference.
- C. Commissioning Plan and Appendices.

1.02 SUMMARY

- A. Section includes for Mechanical, Electrical, Plumbing and associated systems:
 - 1. Functional Testing of systems.
 - 2. Documentation of Functional Tests.
 - 3. Acceptance criteria.
- B. Scope.
 - 1. This section describes Functional Testing (FT) procedures and requirements. It describes the General Contractor's and Sub-contractors' requirements for supporting the Commissioning Provider (CxP) with functional testing of systems. The section also identifies the level to which systems and equipment will be tested to be accepted by the Owner.
- C. Related Sections:
 - 1. Section 017900 Demonstration and Training
 - 2. Section 019113 General Commissioning Requirements.
 - 3. Section 220800 Commissioning of Plumbing System
 - 4. Select Division 22 Plumbing Specifications
 - 5. Section 230800 Commissioning of HVAC System
 - 6. Select Division 23 HVAC Specifications
 - 7. Section 260800 Commissioning of Electrical System
 - 8. Select Division 26 Electrical Specifications

1.03 DEFINITIONS

A. Refer to Section 019113 – General Commissioning Requirements.

1.04 FUNCTIONAL TESTING

A. Overview.

- 1. Functional testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes and are run through all the control system's sequences of operation and components are verified to be responding as the sequences state.
- 2. The CxP develops the Functional Test Procedures and monitors the actual testing. Due to equipment warranties, the installing contractor or vendor manipulates the controls or equipment as described in the tests.

B. Functional Test Procedures.

- 1. This Specification contains the functional test criteria and Functional Test Plan. The CxP will develop final tests with information such as: change orders, updated points list, control sequences and setpoints, input from contractors, and input from the A/E.
- 2. Functional testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. The CxP follows the Specifications and uses judgment where needed to determine which method is most appropriate.
- 3. The CxP reviews Owner-contracted, factory, or required Owner acceptance tests and determines what further testing may be required to comply with the Specifications. Redundancy is minimized.
- 4. The Subs shall provide their reviews of the Functional Test Procedures created by the CxP to the GC for review by the CxP, A/E, and PM at least three (3) weeks prior to the performance of the associated test. Subject to conformance with the Specifications and Commissioning Plan, the CxP, A/E, and PM will approve the Functional Test Procedures.
- 5. The following procedures will be used for this project for the development and approval of Functional Test Procedures:
 - a. The CxP develops Functional Test (FT) Procedures. This Specification is the basis for the Functional Tests. The CxP transmits the FT Procedures to the General Contractor (GC) and copies the Project Manager (PM).
 - b. The GC transmits the FT Procedures to the responsible Sub-contractors (Subs) for their review.
 - c. The designated Subs review the FT Procedures for feasibility, safety, warranty, and equipment protection. The Subs shall submit comments on FT procedures to the GC.
 - d. The CxP, Architect, Engineer, and PM review and approve the FT Procedures and convey approval to the GC.

C. Execution of Functional Test Procedures.

- 1. The CxP organizes and directs the Functional Test Procedures.
- 2. The Subs support performance of the Functional Test Procedures at the direct of the CxP. The CxP records test results.
- 3. The CxP monitors and witnesses the functional testing of commissioned equipment and systems.
- 4. Four (4) weeks prior to functional testing, the Subs schedule the functional tests with the GC and CxP.

D. Test Documentation.

- 1. The CxP will conduct and/or witness tests. The CxP will record all test results on the forms developed for testing. CxP will "Pass" or "Fail" the testing and record the date and time for the test. Deficiencies shall be clearly indicated when the test is failed. When all related testing is completed successfully, CxP shall recommend acceptance of the system or component.
- E. Deficiencies and Re-Testing: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can continue to successful completion. More significant deficiencies will require the failure of the test and re-testing at no cost to the Owner.
- F. Sampling: Some types of identical equipment (such as terminal devices) may be tested using a sampling strategy. The sample percentage is indicated in the Commissioning Plan.

- G. Seasonal Testing: If directed by the CxP, testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. Opposite season testing will be required where scheduling prohibits thorough testing in all modes of operation.
- H. Approval: The CxP and A/E will review and approve or disapprove the test results based on methods, results and completeness of the specific data collected.

1.05 FUNCTIONAL TEST ACCEPTANCE CRITERIA

- A. In general, the acceptance criteria shall be as follows unless more specifically indicated within individual tests, by Owner, or A/E. Deviations from these acceptance criteria will be discussed with Owner and A/E.
 - 1. Capacity and/or equipment performance will generally be as specified +/- 5%.
 - 2. Efficiency where specifically indicated in the documents will be +/- 5%. When inferred from manufacturer's catalog data, criteria will be +/- 10%.
 - 3. Balancing-related criteria will be \pm 5% for water and \pm 10% for air.
 - 4. Accuracy/repeatability on sensing devices will be as specified for the device. CxP and TAB will use calibrated gauges for independent validation and use judgment in passing or failing the devices. In many cases, the coordination of multiple related sensors is more important than absolute accuracy.
 - 5. Loop response and setpoint deviation criteria will be as specified in Division 23.
 - 6. HVAC sequence-related criteria will be as explicitly specified in the documents and as interpreted by the CxP. Code required sequencing shall be per the applicable code.
 - 7. System sequences shall be as required by the approved shop drawings.
 - 8. Motor phase imbalance: shall be no more than 2% (Amps and Volts.)
 - 9. Noise Levels:
 - a. Occupied spaces: Noise levels shall be as recommended in the design documents or the most current version of the ASHRAE standards for the applicable occupancy when design requirements are not specified.
 - 10. Indoor Environmental Parameters (T, RH, CO2, VOC): As indicated by the design documentation or as recommended in the most current version of the ASHRAE Handbooks for the applicable occupancy.
 - 11. Air Pressurization: As indicated by the design documentation. Smoke/shaft pressurization shall be as required by NFPA to maintain maximum door opening forces and restrict the passage of smoke.
 - 12. Indoor Lighting Levels: As indicated by the design documentation.
 - 13. Electrical Systems: Shall be in accordance with manufacturers' recommendations of individual components and devices, NFPA 70B and International Electrical Testing Association (NETA) testing specifications NETA ATS-Latest Version.
 - 14. Inter-system interfaces and coordination: As specified and generally to ensure safe, reliable, and robust operation.
- B. Max Failure Limit and Sample Percentages: A Maximum Failure Limit is indicated along with the Sampling Percentages. The Max Failure Limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. This is based on the concept that if many failures occur, it is a result of inadequate start-up by the Contractor. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.
 - 1. If no Max Failure Limit is indicated, all tested samples must pass (Max Failure Limit = 0%).
 - 2. Where sample tests involve multiple systems (i.e. checking strainers on different hydronic systems) the Max Failure Limit will apply per system.
 - 3. The responsible Contractors shall redo the start-up/TAB for the applicable devices and systems.
 - 4. All work necessitated by sample failures shall be at no cost to the Owner.

5. Regardless of whether the Maximum Failure Limit is reached, the Contractor is responsible for correcting all deficiencies identified during the testing.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION

- A. General: All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the specified tolerances. All equipment shall be calibrated according to manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available. Supplier of instrumentation shall submit the calibration certificates along with the start-up documentation.
 - 1. Standard Testing Instrumentation: Standard instrumentation normally used for performance assessment and diagnosis will be provided by the CxP for tests being exclusively performed by the CxP, for all other tests provided by the Contractor.
- B. Special Instruments and Tools: Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these contract documents shall be included in the base bid price by the Contractor and provided to the Owner.

PART 3 - FUNCTIONAL TEST REQUIREMENTS

3.01 PRE-REQUISITES

- A. Functional Testing Plan.
 - 1. The Functional Testing Plan provides the Contractors with information about where functional testing lies in the schedule, what issues are preventing the start of testing, and which contractors are needed for each test. This plan includes the following information: equipment/system, whether the test includes prerequisites, needed participants at testing, and whether there is anticipated seasonal testing. The Functional Testing Plan is finalized after most equipment has been started up and when functional testing dates are approaching.
 - 2. The Functional Testing Plan is attached to this Specification section.
 - 3. The control system is tested before it is used to verify performance of other components or systems.
 - 4. The air balancing, water balancing, and circuit testing is completed and debugged before functional testing of air-related or water-related equipment or systems.
 - 5. Testing proceeds from components to subsystems to systems and finally to interlocks and connections between systems.

B. Approvals and Documentation.

- 1. Construction checklists completed, submitted, and approved by CxP as ready for functional testing.
- 2. Start-up completed for each piece of equipment and startup reports submitted and approved by CxP as ready for functional testing.
- 3. Functional testing procedures reviewed and approved by installing contractor.
- 4. All control system functions and interlocks are programmed and operable per contract documents, including final setpoints and schedules with debugging and loop tuning completed
- 5. Instrument, sensors, and device calibration checks completed.
- 6. Control system trending configured and operational for all points identified in contract documents.
- 7. Test and balance (TAB) completed and approved by CxP as ready for functional testing.

- 8. All Corrective Action and A/E punch list items resolved.
- 9. Safeties and operating ranges for each piece of equipment reviewed.
- 10. False loading equipment, systems and procedures provided and available (boilers, preheat or reheat coils, control loops, over-ride on OSA dampers, etc.)

3.02 FUNCTIONAL TESTING PROCESS

- A. Functional Testing on any given system shall generally begin with testing device level elements; progress to component level; to system level, to inter-system level to building level.
- B. Functional Testing of systems shall generally proceed from the utilities to the central systems, to the distribution systems, to the zone terminal units and services.
- C. All operating modes, interlocks, control responses, and responses to abnormal or emergency conditions shall be tested verify proper response of building automation system controllers and sensors verified.
- D. Tests will be performed using design conditions whenever possible.
- E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions.
- F. The Commissioning Provider may direct that set points be altered when simulating conditions is not practical.
- G. The Commissioning Provider may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- H. If tests cannot be completed because of a deficiency outside the scope of the commissioned systems, the deficiency shall be documented and reported to the General Contractor and Commissioning Provider. After deficiencies are resolved, tests shall be rescheduled.
- I. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be performed and documented, and seasonal portions scheduled.

3.03 COMMON ELEMENTS FOR ALL SYSTEMS

- A. BAS and local controller panel graphics: The graphic displays for all components, systems, and areas required to be represented by the graphics shall be checked for adequacy and accuracy. Setpoints and other adjustable parameters shall be checked for functionality.
- B. Where systems and zones are designed for various modes of operation, systems shall be tested to simulate all modes, including, but not limited to:
 - Seasonal Modes.
 - 2. Sequencing Modes.
 - 3. Emergency Modes.
- C. The intent of "Verify and Document" shall include, but not be limited to, the following:
 - 1. Taking the system or device through its entire range of control.
 - 2. Subjecting the system or device to all normal and emergency operating modes.
 - 3. Simulating system or device power and/or communications failure and documenting response.
 - 4. Simulating system or device conditions of increasing and decreasing load.

3.04 DOMESTIC HOT WATER SYSTEM

- A. Summary: Functional Testing of domestic hot water heater(s), re-circulating domestic hot water distribution, and controls.
- B. Participants:
 - 1. Commissioning Provider
 - 2. Mechanical Contractor
 - 3. Controls Contractor
- C. Minimum allowable sample rate: 100%
- D. Percent of testing Witnessed by CxP: 100%
- E. Scope of Testing:
 - 1. Verify and document operation of the domestic hot water heater(s).
 - 2. Verify and document tempering mixing valve operation.
 - 3. Verify and document temperature control and reset strategies.
 - 4. Verify and document safeties.
 - 5. Verify and document operation of circulating pumps.
 - 6. Verify and document any interface with BAS.

3.05 ELEVATOR SUMP PUMPS

- F. Summary: Functional Testing of elevator sump pump(s) and controls.
- G. Participants:
 - 1. Commissioning Provider
 - 2. Mechanical Contractor
 - 3. Controls Contractor
- H. Minimum allowable sample rate: 100%
- I. Percent of testing Witnessed by CxP: 100%
- J. Scope of Testing:
 - 1. Verify and document operation of the elevator sump pump(s).
 - 2. Verify and document safeties.
 - 3. Verify and document any interface with BAS.

3.06 NATURAL GAS FLOW METERING

- K. Summary: Functional Testing of natural gas flow metering and controls.
- L. Participants:
 - 1. Commissioning Provider
 - 2. Mechanical Contractor
 - 3. Controls Contractor
- M. Minimum allowable sample rate: 100%
- N. Percent of testing Witnessed by CxP: 100%

- O. Scope of Testing:
 - 1. Verify and document installation of natural gas meter.
 - 2. Verify and document any interface with BAS.

3.07 HEATING HOT WATER SYSTEM

- A. Summary: Functional Testing of hot water boilers, hot water distribution system, and controls.
- B. Participants:
 - 1. Commissioning Provider.
 - 2. Mechanical Contractor.
 - 3. Controls Contractor.
- C. Minimum allowable sample rate: 100%.
- D. Percent of testing witnessed by CxP: 100%.
- E. Scope of Testing:
 - 1. Verify and document staging of [heat recovery chiller and] gas fired boilers.
 - 2. Verify and document [heat recovery chiller and] boiler circulating pumps operation.
 - 3. Verify and document temperature control and reset strategies
 - 4. Verify and document hot water distribution pump startup, staging and shutdown sequences.
 - 5. Verify and document hot water distribution pump speed control, differential pressure setpoints, and reset strategies.
 - 6. Verify and document miscellaneous controls (lockouts, interlocks.)
 - 7. Verify and document failure modes responses.
 - 8. Verify and document safeties.
 - 9. Verify and document interface with BAS.

3.08 CHILLED WATER SYSTEM

- A. Summary: Functional Testing of air-cooled chiller, chilled water distribution system, and controls.
- B. Participants:
 - 1. Commissioning Provider.
 - 2. Mechanical Contractor.
 - Controls Contractor.
- C. Minimum allowable sample rate: 100%.
- D. Percent of testing witnessed by CxP: 100%.
- E. Scope of Testing:
 - 1. Verify and document chiller startup, staging, and shutdown sequences including optimal start/stop strategies.
 - 2. Verify and document chilled water temperature control and reset strategies.
 - 3. Verify and document chilled water distribution pump startup, staging and shutdown sequences.
 - 4. Verify and document chilled water distribution pump speed control, differential pressure setpoints and reset strategies.
 - 5. Verify and document chiller energy consumption optimization and miscellaneous controls (lockouts, interlocks)
 - 6. Verify and document failure mode responses

- 7. Verify and document safeties and emergency shutdown sequences.
- 8. Verify and document interface with BAS.

3.09 DEDICATED OUTDOOR AIR UNITS

- A. Summary: Functional Testing of the Dedicated Outdoor Air Units
- B. Participants:
 - 1. Commissioning Provider
 - 2. Mechanical Contractor
 - 3. Controls Contractor
- C. Minimum allowable sample rate: 100%
- D. Percent of testing Witnessed by CxP: 100%
- E. Scope of Testing:
 - Verify and document the dedicated outdoor air unit startup and shutdown sequences including optimal start/stop strategies.
 - 2. Verify and document the sensor calibration, temperature control and reset sequences.
 - 3. Verify and document dedicated outdoor air unit operation in heating and ventilating modes.
 - 4. Verify and document miscellaneous controls (filter pressures, interlocks, etc.).
 - 5. Verify and document safeties.
 - 6. Verify and document interface with BAS.

3.10 DX SPLIT SYSTEM

- A. Summary: Functional Testing of the DX Split System Units
- B. Participants:
 - 1. Commissioning Provider
 - 2. Mechanical Contractor
 - 3. Controls Contractor
- C. Minimum allowable sample rate: 100%
- D. Percent of testing Witnessed by CxP: 100%
- E. Scope of Testing:
 - 1. Verify and document the Dx Split System unit startup and shutdown sequences including optimal start/stop strategies.
 - 2. Verify and document the sensor calibration, temperature control and reset sequences.
 - 3. Verify and document miscellaneous controls (filter pressures, interlocks, etc.).
 - 4. Verify and document safeties.
 - 5. Verify and document interface with BAS.

3.11 FAN COIL UNITS

- A. Summary: Functional Testing of fan coil units and controls.
- B. Participants

- 1. Commissioning Provider
- 2. Controls Contractor
- 3. Mechanical Contractor
- C. Minimum allowable sample rate: 100%.
- D. Percent of testing witnessed by CxP: 100%.
- E. Scope of Testing:
 - Verify and document cooling/heating sequences are implemented in accordance with contract documents.
 - 2. Verify and document zone temperature sensor calibration and set-points.
 - 3. Verify and document night-setback and morning warm-up.
 - 4. Verify and document interface with BAS.

3.12 GENERAL EXHAUST FANS

- A. Summary: Functional Testing of the fans
- B. Participants:
 - 1. Commissioning Provider
 - 2. Mechanical Contractor
 - 3. Controls Contractor
- C. Minimum allowable sample rate: 100%
- D. Percent of testing Witnessed by CxP: 100%
- E. Scope of Testing:
 - 1. Verify and document the fan's startup and shutdown sequences.
 - 2. Verify and document the sensor calibration and temperature control sequences where applicable.
 - 3. Verify and document fan operation in applicable operating modes.
 - 4. Verify and document miscellaneous controls (interlocks, etc.).
 - 5. Verify and document safeties.
 - 6. Verify and document interface with BAS.

3.13 BUILDING AUTOMATION SYSTEM CONTROL INTERFACES AND REPORTS

- A. Summary: Functional Testing of the control system interfaces with elevator, and electrical systems as required, and testing of BAS reporting functions.
- B. Participants:
 - 1. Commissioning Provider
 - 2. Mechanical Contractor
 - 3. Controls Contractor
 - 4. Fire Alarm Contractor
 - 5. Fire Suppression Contractor
 - 6. Electrical Contractor
- C. Minimum allowable sample rate: 100%
- D. Percent of testing Witnessed by CxP: 100%

E. Scope of Testing:

- 1. Verify and document interface between BAS, and elevator systems.
- 2. Verify and document Alarm initiation and response between systems is consistent with contract documents.
- 3. Verify and document interlocks between systems are consistent with contract documents.
- 4. Verify trends and history information is being generated and stored.
- 5. Verify BAS graphics are appropriate and accurate.

3.14 OCCUPANCY SENSOR AND SCHEDULED LIGHTING CONTROL

- A. Summary: Functional Testing of the room lighting control by occupancy and schedule
- B. Participants:
 - 1. Commissioning Provider
 - 2. Electrical Contractor
 - Controls Contractor
- C. Minimum allowable sample rate: 100%
- D. Percent of testing Witnessed by CxP: 100%
- E. Scope of Testing:
 - 1. Verify and document the occupancy sensors function.
 - 2. Verify and document the space sensor calibration,
 - 3. Verify and document interlocks with other components.
 - 4. Verify and document any interface with BAS.

END OF SECTION 019113.13

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alterations purposes.
- C. Selective demolition of existing utilities and utility structures.
- D. Demolition of the existing roofing and associated roof items.
- E. Patching and repairs of existing elements to remain.

1.02 RELATED SECTIONS

- A. Section 311000 Site Clearing: Vegetation and existing debris removal.
- B. Section 312200 Grading: Topsoil removal.
- C. Divisions 21 through 28 Sections for or relocating of site mechanical and electrical items.

1.03 REFERENCES

- A. 29 CFR 1926 U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2004.

1.04 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.
- B. Remove and salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- D. Existing to remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled. Protect construction indicated to remain against damage and soiling during selective demolition.

1.05 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

1.06 SUBMITTALS

- A. Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.
- B. Selective Demolition Plan: Submit selective demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of selective demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 - 2. Indicate starting and ending dates for each activity.
 - 3. Identify demolition firm and submit qualifications.
 - 4. Include a summary of safety procedures.
 - 5. Coordination for shutoff, capping, and continuation of utility services.

- 6. Locations of temporary protection and means of egress.
- 7. Use of elevator and stairs.
- 8. Detailed sequence of selective demolition and removal work to ensure Owner's uninterrupted continuing occupancy of adjacent buildings and partial use of premises.
- C. Proposed Dust-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed location, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- D. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before work begins.
- E. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.07 QUALITY ASSURANCE

- A. Conference: Conduct conference at Project site to comply with requirements in Division 1 sections. Review methods and procedures related to building demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.

1.08 PROJECT CONDITIONS

- A. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far a practical.
- B. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- C. Storage or sale of removed items or materials on-site is not permitted.

1.09 HAZARDOUS MATERIALS

- A. Hazardous Materials: It is not expected that hazardous material will be encountered in the work.
 - If material suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill Material: As specified in Section 312200 Grading
- B. Repair Materials: Use repair materials identical to existing materials.
 - 1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of existing building as indicated on the drawings.

- B. Area of building(s) to be selectively demolished will be vacated and their use discontinued before start of Work.
- C. Owner will occupy another area immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
 - 1. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
 - 2. Maintain access to existing walkways, exits, and other adjacent occupied or used facilities.
 - a. Do not close or obstruct walkways, exits, or other occupied or used facilities without written permission from authorities having jurisdiction.
- D. Remove other items indicated, for salvage and relocation.
- E. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditional are the same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to the Architect.
- E. Survey the condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

3.03 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Use of explosives is not permitted.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - a. Maintain adequate ventilation when using cutting torches.
 - 4. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the lower level.
 - 5. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 6. Cut or drill from the exposed surface or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 7. Buildings over one story remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

- a. Remove structural framing members and lower to ground by method suitable to minimize ground impact or dust generation.
- 8. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - a. Locate selective demolition equipment throughout the structure and remove debris and materials so as to not impose excessive loads on supporting walls, floors, or framing.
- 9. Provide, erect, and maintain temporary barriers and security devices.
 - a. Comply with requirements in Division 1 Temporary Facilities and Controls.
- 10. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
- 11. Do not close or obstruct roadways or sidewalks without permit.
- 12. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- 13. Obtain written permission from owners of adjacent properties when selective demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Below-Grade Construction:
 - 1. Remove below-grade construction, including basements, foundation walls, and footings completely.
- E. Site Restoration:
 - 1. Staging, Parking and Storage: Restore lawn areas used for staging and storage of construction materials or parking during the project back to their original condition.
- F. Removed and salvaged items: Comply with the following:
 - 1. Contractor to remove and salvage the following items:
 - a. Wall mounted equipment.
 - 2. Clean salvaged items of dirt and demolition debris.
 - 3. Pack or crate items after cleaning. Identify contents of containers.
 - 4. Store items in a secure area until delivery to Owner.
 - 5. Transport items to Owner's storage area on-site.
 - 6. Protect items from damage during transport and storage.

3.04 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare selective demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.
 - 1. Refer to Divisions 21 through 28 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.05 SELECTIVE DEMOLITION

- A. Drawings showing existing construction and utilities are based on field observation and existing record documents only.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage to structure or interior areas.
- C. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.
- D. Cover and protect furniture, furnishings, and equipment that have not been removed.
- E. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete and promptly remove off-site.
 - 2. Concrete: Cut concrete, in small sections, full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts. Do not use power-driven impact tools.
 - 3. Masonry: Cut masonry, in small sections, at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts. Do not use power-driven impact tools.
 - 4. Concrete Slabs-on Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove, unless otherwise shown to remain.
 - 5. Steel: Dismantle field connections without bending or damaging steel members. Do not use flame cutting torches unless otherwise authorized.
 - a. Steel trusses and joists as whole units without dismantling them further.
 - 6. Ceramic, Porcelain and Quarry Floor Tile and Base: Remove tile, grout, mastic, mudset bed, spacers, mesh and lathe in its entirety to leave remaining subfloor and wall surface in clean, smooth condition ready for new flooring material.
 - Mud/Thick set tile: Remove mud/thickset in its entirety to leave remaining subfloor and wall surface in clean, smooth condition ready for new flooring and fill material.
 - 7. Ceramic, Porcelain Quarry Wall Tile and Base: Remove tile, grout, mastic, spacers, mesh and lathe in its entirety to leave remaining CMU wall surface in clean, smooth condition ready for new wall material.
 - 8. Ceramic, Porcelain Quarry Wall Tile and Base: Remove tile, grout, mastic, spacers, mesh and lathe and backer board in its entirety ready for new backer board installation.
 - 9. Carpet: Remove in large pieces and roll tightly after removing demolition debris, trash, adhesive, tack strips, pad. Remove all adhesives, staples and other carpet securement items

- in their entirety to leave remaining subfloor in clean, smooth condition ready for new flooring material.
- 10. Resilient Floor Covering: Remove resilient floor coverings and adhesive according to recommendations of the Resilient Floor Covering Institutes (RFCI) "Recommended Work Practices for the Removal of Resilient Floor Coverings" and Addendum.
 - Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- 11. Gypsum/Drywall Board Ceilings, Soffits and Bulkheads: Remove gypsum/drywall board, suspension hangers, clips, suspension grid system, furring or other stud support system in its entirety so existing ceiling area is ready to receive new ceiling system.
- 12. HVAC Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
- 13. Remove items indicated on drawings.
- F. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. See Section 011000 for other limitations on outages and required notifications.
 - 4. Verify that abandoned services serve only abandoned facilities before removal.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- G. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.
 - a. Patching is specified in Division 1 Section "Cutting and Patching".
- H. Roofing Demolition:
 - 1. Remove no more existing roofing than can be covered in one day by new temporary roofing.
 - 2. Coordinate removal of existing roofing with installation of new temporary roofing and existing roof drains to remain. Coordinate repairs of existing roof deck with installation of temporary roofing.
 - 3. Provide water cut-offs, that do not create a water dam, at the end of each day's work.
 - 4. Remove existing roofing material by method to avoid damage to existing substrates.
 - 5. Remove debris from the roof by chute, hoist, or other device that will convey debris to grade level in a controlled descent. Do not throw materials from the roof.
 - 6. Do not traverse re-roofed areas to carry removed materials to chutes; where possible, relocate chutes to areas where demolition is occuring.
 - 7. Provide temporary walkways, as required, to protect existing substrates from damage by roofing operations.
 - 8. See applicable Division 7 Section for new roofing requirements.

3.06 DEBRIS AND WASTE REMOVAL

- A. Except for items or materials indicated to be reused, salvaged, and reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.

- 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Transport demolished materials from Owner's property and legally dispose of them..
- C. Transport demolished materials approved for fill and dispose of at designated spoils areas on Owner's property.
- D. Do not burn demolished materials on site.
- E. Leave site in clean condition, ready for subsequent work.
- F. Clean up spillage and wind-blown debris from public and private lands.
- G. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return to condition existing before start of selective demolition.

END OF SECTION 024119

SECTION 030300 - STRUCTURAL EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Structural Excavation and Backfill includes:
 - 1. Preparing subgrades for slabs on grade.
 - 2. Excavating and backfilling for building foundations from subgrade.
 - 3. Over-excavation and structural backfill to achieve adequate support for foundations.
 - 4. Subsurface drainage backfill for foundation walls.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Special Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 31 Section "Dewatering."
 - 4. Division 31 Section "Earth Moving."
 - 5. Division 33 Section "Subdrainage."

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material (flowable fill) used to fill an excavation.
- B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- C. Drainage Course: Free-draining aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- D. Excavation: Removal of material encountered above bearing elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation (Over-excavation): Excavation below bearing elevations or beyond indicated lines and dimensions as directed by Special Inspector and confirmed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for [unit prices] [changes in the Work]. No work performed through or into mass undercut or mass fill performed as part of this Construction Project or required to remediate inadequate Dewatering/Rainwater Control practices or required to remediate wet/freezing weather will be applicable for Authorized Additional Excavation payment.
 - 2. Bulk (Mass) Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below bearing elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- E. Fill: Soil materials used to raise existing grades.

- F. Structures: Buildings, footings, foundations, retaining walls, slabs, or other man-made stationary features constructed above or below the ground surface as shown on the structural drawings.
- G. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, GC, SW, SP, SM, SC, CH, and CL according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. No concentration of large fragments is permitted unless approved by Geotechnical Engineer and Architect.
 - 1. Plasticity Index: Less than 30.
 - 2. Liquid Limit: Less than 50.
 - 3. Swell potential: Less than 50 psf.
 - 4. Maximum dry density of at least 100 pounds per cubic foot.
- C. Unsatisfactory Soils: Soil Classification Groups ML, OL, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
 - 2. Shot rock, asphalt, and coal fragments.
 - 3. Organics content shall be less than 5%. Limit total depth of soil fills with organic contents over 4% to 24".
- D. Subbase Material (Dense Graded Aggregate): Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; meeting Kentucky Transportation Cabinet Standard Specification for dense graded aggregate; with at 3/4" maximum nominal size aggregate and not more than 13 percent passing a No. 200 sieve.
- E. Drainage Course and Drainage/Wall Backfill (Crushed Stone): Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; meeting Kentucky Transportation Cabinet

Standard Specification for #57 stone; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.2 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material Performance Additive:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Darafill or Darafill Dry, W.R. Grace & Co.
 - b. Rheomac VMA 362, BASF Corporation Admixture Systems
- B. Prohibited Admixture: Calcium chloride thiocyanates or admixture containing more than 0.05 percent chloride ions.
- C. Controlled Low Strength Material CLSM (Flowable fill): Self-compacting, flowable concrete material. Provide blend of cement, flyash, and sand with minimum cementitious content as follows:
 - 1. Excavatable flowable fill: 100 lb cement and 250 lb fly ash per cubic yard.
 - 2. Structural flowable fill (250 psi): 175 lb cement and 200 lb fly ash per cubic yard. Add CLSM performance additive at manufacturer's recommended dosage rate, adjusting water content to provide desired flow and strength characteristics.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- C. All undercut and engineered backfill remedial work recommended by the Special Inspector and caused by inadequate dewatering and drainage practices during construction shall be provided at no additional cost to Owner.

3.3 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
- B. All overexcavation of soft and/or saturated soils caused by dewatering/rainwater control practices and wet/freezing weather, excavation of soils into mass undercut or mass fill performed as part of this Construction Project, and subsequent backfill, as directed by Special Inspector shall be performed at no additional cost to Owner. Contractor shall notify Construction Manager of work required, perform work where directed by Construction Manager, and coordinate with other trades who may be required to perform such work.

3.4 STRUCTURAL EXCAVATION

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for footings and foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Recompact areas loosened by excavation operations prior to reinforcing steel placement.
 - 3. Remove loose soil, debris, and excess surface water from the bearing surface prior to concrete placement.
- B. Over-excavate all soft and deleterious material below foundations as directed by Special Inspector and backfill back to foundation bearing elevation with approved fill material.
- C. For foundations classified as soil bearing on the structural drawings, undercut and maintain similar bearing material type and depths.
 - 1. Remove all rock within one footing width below bottom of foundation and replace with approved engineered soil backfill.

3.5 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Special Inspector determines that unsatisfactory soil is present, notify Architect and receive direction. Once received, continue excavation and replace with compacted backfill or fill material as directed.

- C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 1500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL, GENERAL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Do not backfill below footings with crushed stone where building foundations classified as soil bearing on the structural drawings.

3.9 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact engineered fill material in layers to required elevation.
- C. Place fill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

- 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
- 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight. Maintain the moisture content as such.

3.11 COMPACTION OF SOIL/GRAVEL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill gravel (KYTC #57 stone) in layers not more than 8 inches in loose depth and tamp in place. Use hand-operated tampers (plate compactors) where grade differential, at time of tamping, is more than 12-inches on each side of wall or where backfill area extent or accessibility does not facilitate the use of heavy compaction equipment.
- C. Place backfill gravel and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
 - 2. When the fill depth will exceed 10 feet, the excess lower portion shall be compacted to at least 100 percent.

3.12 CEMENTITIOUS FILL

- A. Place fill on subgrades free of mud, frost, snow, or ice.
- B. Place and consolidate in accordance to the recommendations of the Geotechnical Report.

3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBBASE UNDER CONCRETE SLABS-ON-GRADE

- A. Place subbase on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact subbase under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place subbase 6 inches or less in compacted thickness in a single layer.

- 2. Place subbase that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
- 3. Compact each layer of subbase to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.15 FIELD QUALITY CONTROL

- A. General: The Owner will employ a testing agency that meets the requirements of ASTM E329 to perform tests and to submit test reports. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered or obligate the Architect or Owner for final acceptance.
 - 1. See Section 014110 Structural Special Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Test results will be reported in writing to the Architect, Engineer, and General Contractor within 24 hours after tests.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent backfill or foundation placement only after test results for previously completed work comply with requirements.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 030300

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. This section applies to concrete work shown on the structural drawings. See Division 32 for site concrete.
- B. Cast-in-place concrete includes the following:
 - Lean concrete backfill and mudmats.
 - 2. Foundations and footings.
 - 3. Slabs-on-grade.
 - 4. Fill for steel deck.
 - 5. Foundation walls.
 - 6. Equipment pads and bases.
 - 7. Grout below column base and bearing plates.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - Division 1 Section "Structural Special Inspection."
 - 2. Division 3 Section "Structural Excavation and Backfill" for preparation and excavation of foundations and stone drainage fill.
 - 3. Division 5 Section "Structural Anchors."
 - 4. Division 5 Section "Steel Deck."
 - 5. Division 7 Section "Thermal and Moisture Protection."
 - 6. Division 31 Section "Earth Moving" for preparation and excavation of foundations and stone drainage fill.
- D. Coordination: Unless other satisfactory agreements are specifically entered into by contractors concerned, all miscellaneous iron and steel, sleeves, anchors, etc., required by work of other contractors, will be furnished and installed by such other contractors with the cooperation of this contractor.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.

- B. Design Mixtures: For each concrete mixture with laboratory test reports for the following data. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Method used to determine the proposed mix design (per ACI 301, Section 4).
 - 2. Gradation and quantity of fine and coarse aggregates.
 - 3. Proportions of all ingredients including all admixtures added either at the time of batching or at the job site. Indicate amounts of mixing water to be withheld for later addition at Project site.
 - 4. Water/cement ratio and water/cementitious ratio.
 - 5. Slump ASTM C143.
 - 6. Certification and test results of the total water soluble chloride ion content of the design mix FHWA RD-77 or AASHTO T 260-84.
 - 7. Air content of freshly mixed concrete by the pressure method, ASTM C231, or the volumetric method, ASTM C173.
 - 8. Unit weight of concrete ASTM C138.
 - Strength at 7- and 28-days for structural concrete— ASTM C39. Document strength on basis of previous field experience or trial mixtures, per ACI 301 Section 4. Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard calculation, and determination of required average compressive strength.
 - 10. Complete and include Structural Engineer's standard mix design submittal form for each mix. A blank copy is included at the end of this section.
- C. Steel Reinforcement Shop Drawings: Fabrication and placing drawings for reinforcement detailing, fabricating, bending, and placing concrete reinforcement. Comply with ACI SP-066(04) "ACI Detailing Manual" showing bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Include special reinforcing required for openings through concrete structures.
 - Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files. Rules for use of said files shall be as defined in the CRSI "Code of Standard Practice" Sections 4.19 and 6.4.1.
 - 2. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.
- D. Product Data: For proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, vapor retarder/barrier, construction joint slip dowels, joint systems, mechanical reinforcing splice couplers, fiber reinforcing, curing compounds, dry-shake finish materials, and others if requested by Architect.
- E. Samples of materials as requested by Architect, including names, sources, and descriptions, as follows:
 - 1. Vapor retarder/barrier.

1.5 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Welding certificates.

- C. Laboratory test reports for concrete materials or material certificates in lieu of material laboratory test reports. Material certificates shall be signed by Manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- D. Survey of the as-built locations of anchor rods, foundation bolts, and other embedded items shall be submitted to the Architect, Engineer, and General Contractor/Construction Manager.
- E. Written notification that the concrete in the footings, piers, walls, or other bearing support has attained, on the basis of an appropriate ASTM standard test method of field-cured samples, a minimum of 75% of the intended minimum compressive design strength.
- F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Each contractor having reference to ACI Documents shall maintain copies of same on project site.

AMERICAN CONCRETE INSTITUTE

- 1. ACI 117-10 Specifications for Tolerances for Concrete Construction and Materials.
- 2. ACI 211.1-91 Standard Practice for Selecting Proportions Normal, Heavyweight and Mass Concrete (Reapproved 2009).
- 3. ACI 301-10 Specification for Structural Concrete.
- 4. ACI 302.1R-04 Guide for Concrete Floor and Slab Construction.
- 5. ACI 304.2R-96 Placing Concrete by Pumping Methods (Reapproved 2008).
- 6. ACI 305R-10 Guide to Hot Weather Concreting.
- 7. ACI 306R-10 Guide to Cold Weather Concreting.
- 8. ACI 308R-01 Guide to Curing Concrete (Reapproved 2008).
- 9. ACI 309R-05 Guide for Consolidation of Concrete.
- 10. ACI 311.1R-07 ACI Manual of Concrete Inspection.
- 11. ACI 318-14 Building Code Requirements for Structural Concrete and Commentary.
- 12. ACI 347-04 Guide to Formwork for Concrete.
- 13. SP-66 ACI Detailing Manual.

CONCRETE REINFORCING STEEL INSTITUTE (CRSI):

- CRSI Manual of Standard Practice.
- 2. CRSI 63 Recommended Practice for Placing Reinforcing Bars.
- 3. CRSI 65 Recommended Practice for Placing Bar Nomenclature.
- B. Qualifications of Workers: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper execution of the work required by this Division.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's Certification of Ready Mixed Concrete Production Facilities.

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" and the following:
 - 1. At least 35 days prior to start of the concrete construction schedule, the contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction.
 - 2. The contractor shall require responsible representatives of every party who are concerned with the concrete work to attend the conference, including but not limited to, the following:
 - a. Contractor's superintendent Laboratory responsible for the concrete design mix Laboratory responsible for field quality control Concrete subcontractor Ready-mix concrete producer Admixture manufacturer(s) Concrete pumping contractor Special Inspector Polishing Installer.
 - 3. The Architect and the Owner's Representative may be present at the conference. The Contractor/Construction Manager shall notify the Architect at least five days prior to the scheduled date of the conference.
 - 4. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by them to all parties concerned within five days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner's representative Resident engineer Consultant engineer.
- E. Contractor shall be responsible for conducting a survey of the as-built locations of anchor rods, foundation bolts, and other embedded items. Survey to include embed placement, bolt projection, and top of foundation elevation. Survey to be conducted by a Professional Land Surveyor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver steel reinforcement and concrete to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel reinforcement off ground by using pallets, platforms, dunnage, or other supports and spacers.
- C. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- D. Store waterstops and packaged materials in sealed containers with manufacturer's labels intact. Place under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed (Smooth) Finish Concrete: Exterior-grade high-density overlay (Class 1 or better), medium-density overlay (Class 1 or better with mill-release agent treated and edge sealed), or Structural1 or Class 1 (B-B or better, mill oiled and edge sealed) plywood panels complying with DOC PS1; or new metal-framed and metal faced panels; or other acceptable panel-type materials to provide continuous, straight, and smooth exposed surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Forms for Unexposed, Rough-Formed Finish Concrete: Plywood, lumber, metal or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Chamfer Strips: Non-staining dressed wood, metal, PVC, or rubber strips; ¾ by ¾ inch, minimum, and as shown on Drawings; in longest practical lengths.
- D. Form-Release Agent: Commercially formulated form-release agent with a maximum volatile organic compounds (VOCs) not to exceed those allowable by jurisdictional regulations that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties (Standard): Factory-fabricated, adjustable-length, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of plastic concrete on forms, prevent form deflection, and to prevent spalling of concrete upon removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
- F. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum ¼ inch thick.
- G. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or S, Grade NS, that adheres to form joint substrates.
- H. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Fabric: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- D. Smooth Joint Dowel Bars: ASTM A36, plain-steel bars, cut true to length with ends square and free of burrs.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- F. Fabric Supports: Chairs for spacing, supporting welded wire fabric in place. Use continuous wire chairs complying with CRSI specifications.

- 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
- 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - Portland Cement: ASTM C 150, Type I. High early strength (when specified), ASTM C150, Type III. One brand of cement shall be used throughout Project duration unless otherwise acceptable to Engineer.
 - 2. Fly Ash: ASTM C 618, Class F or C, except maximum loss on ignition: 3%.
 - 3. Slag Cement: ASTM C 989, Grade 100 or 120.
 - 4. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag, Type IP, portland-pozzolan, Type IL, portland-limestone, or Type IT, ternary blended cement.
 - 5. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33 Class 3S coarse aggregate or better, graded, and as specified. Provide aggregates from a single source for exposed concrete.
 - For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances considered deleterious or that cause spalling or surface discoloration due to oxidation.
 - 2. Fine Aggregate to be free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 1602 and potable.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
 - 5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 7. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
 - 8. Air-Entraining Admixture: ASTM C 260.
- F. Controlled Low Strength Material (CLSM) Performance Additive
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Darafill or Darafill Dry, GCP Applied Technologies, Inc.
 - b. MasterMatrix VMA 362, BASF Corporation.
 - c. RUSS-FLO, RussTech Admixtures, Inc.

- G. Crystalline Waterproofing Additive: Concrete waterproofing and protection system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure within the pores and capillary tracts of the concrete.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Xypex Admix C-500, Xypex Chemical Corporation.
 - 2. Dosage Rate: Under normal conditions, the crystalline waterproofing powder shall be added to the concrete mix at the following rate:
 - a. 2% 3% by weight of cement content.

2.4 RELATED MATERIALS

- A. Construction joint slip dowels: steel rod or plate in a plastic insert to allow contraction of the concrete while preventing vertical differential displacement.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. #4x1'-6" long, Speed Dowel by Sika Greenstreak.
 - b. 1/4" plate, Diamond Dowel by PNA, Inc.
 - c. 1/4" plate, Speed Plate by Sika Greenstreak.
- B. Slab Pourstop with mechanical shear transfer: galvanized steel, vinyl, or plastic forming pourstop with integral keyway or pre-drilled holes with dowel bars at 12" on center for use with slabs on grade.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Key-Loc Joint System, Cardinal Manufacturing Company, Inc.
 - b. K-Form system with ¾" diameter by 18" smooth dowels (minimum), Victory Bear Construction Products.
- C. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
 - 1. Manufacturers: Subject to compliance with requirements manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
 - a. GCP Applied Technologies Inc.
 - b. Sika Greenstreak.
- D. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or non-impregnated, flexible, synthetic foam with standard bonding agent to hold in place.
- E. Sheet Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:
 - Polyolefin/Resin or multi-ply extrusion coated polyethylene sheet not less than 10 mils thick conforming to ASTM E 1745 Class A. Maximum water vapor permeance when tested in accordance with Test Method ASTM E154, Sections 7, 8, 11, 12, and 13

- (based on ASTM E96) or ASTM F1249 of 0.038 perms. Minimum tensile strength when tested to ASTM D154 of 45 lbs-force/inch.
- 2. Accessories: All must be from the same manufacturer of the vapor barrier material used, or must be approved by the vapor barrier manufacturer in writing and submitted to the Architect for record.
 - a. Seams: Manufacturer approved seam tape.
 - b. Sealing Permanent penetrations of vapor retarder: Manufacturer approved vaporproofing mastic or tape.
 - c. Perimeter edge/seal: Manufacturer approved tape with a textured surface that creates a mechanical seal to freshly-placed concrete, termination bar, or double-sided sealant tape.
 - d. Non-permanent penetration prevention: Manufacturer approved peel and stick stake base/foot and film safe screed system.
- 3. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Perminator Vapor-Mat with Perminator Tape Seal. W.R. Meadows, Inc.
 - b. Stego Wrap with Stego Tape Seal. Stego Industries, LLC.
 - c. Viper Vaporcheck II with manufacturer's recommended tape seal. Insulation Solutions, Inc.
 - d. Vaporblock VB10 with Vapor Bond Plus Tape Seal. Raven Industries, Engineered Films Division.
 - e. Xtreme with Xtreme Tape Seal. Tex-Trude, LP.
- F. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- G. Cartridge Injection Acrylic Adhesive (for reinforcing dowels): two-component material for use in concrete. Anchor to be approved for use with cracked concrete per AC308.
 - 1. Acrylic resin adhesive, suitable for use on dry or damp surfaces. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. HIT HY 200 System, Hilti.
 - b. AC 200+, DeWalt/ Powers.
 - c. AT-XP System, Simpson/Strong-Tie.

2.5 LIQUID FLOOR TREATMENTS

- A. Penetrating Concrete Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - a. BASF Corporation; Construction Systems.
 - b. ChemMasters. Inc.
 - c. Dayton Superior.
 - d. Euclid Chemical Company.
 - e. Kaufman Products, Inc.
 - f. L&M Construction Chemicals, Inc.
 - g. Metalcrete Industries.

- h. PROSOCO, Inc.
- i. SpecChem, LLC.
- j. W. R. Meadows, Inc.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. General: All non-dissipating compounds shall be certified by curing compound manufacturer to not interfere with bonding of floor covering. Where liquid floor treatment or colored stain system is used, provide material recommended by the manufacturer of the treatment for use in a compatible, integrated system. See "Polished Concrete" specification for products and requirements for use on polished concrete floor systems.
- E. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete for temporary protection from rapid moisture loss.
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - a. BASF Corporation.
 - b. ChemMasters, Inc.
 - c. Dayton Superior.
 - d. Euclid Chemical Company.
 - e. Kaufman Products, Inc.
 - f. L&M Construction Chemicals, Inc.
 - g. Lambert Corporation.
 - h. Metalcrete Industries.
 - i. RussTech Admixtures, Inc. (EVRT)
 - j. Sika Corporation.
 - k. SpecChem, LLC.
 - I. W. R. Meadows, Inc.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - a. BASF Corporation.
 - b. ChemMasters, Inc.
 - c. Dayton Superior.
 - d. Euclid Chemical Company.
 - e. Kaufman Products, Inc.
 - f. L&M Construction Chemicals, Inc.
 - g. Lambert Corporation.
 - h. SpecChem, LLC.
 - i. W. R. Meadows, Inc.

- G. Curing Aid/Compound for use with Penetrating Concrete Sealer and Liquid Densifier: Water based clear silicate liquid to harden and dustproof concrete. Product shall be manufactured by same company and compatible with sealer/densifier.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Clear Resin Cure J11W, Dayton Superior.
 - b. Kurez DR VOX, The Euclid Chemical Co.
 - c. Med-Cure, W.R. Meadows, Inc.

2.7 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field data methods, or both, according to ACI 301. Mix proportions shall be established so that the concrete can be placed readily without segregation into forms and around reinforcement under anticipated placement conditions. Use an independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. Trial batch and field experience tests shall have been performed within 24 months of submittal date. Use mix design submittal form included at the end of this section.
 - 1. Do not use the same testing agency for field quality control testing.
- B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect. The approved mix designs shall be used throughout this project unless changes are approved by the Architect/Engineer prior to use.
- C. Cementitious Materials: Supplier shall coordinate surface treatment compatibility with cementitious materials. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 20 percent for Type F or 25% for Type C. Use of fly ash in concrete for use in colored concrete, polished concrete floor systems, or where incompatible with admixtures or other treatments is prohibited.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Slag Cement: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete as required for placement and workability and in all pumped concrete, architectural concrete, and concrete required to be watertight.
 - 2. Use accelerating and retarding admixtures at Contractor's discretion to control set time when required by extreme temperatures or humidity, or other adverse placement conditions. Use accelerating admixture in concrete slabs placed at ambient temperatures below 35 deg F.
 - 3. Use Crystalline Waterproofing Additive and Shrinkage Reducing Admixture at exterior elevated slabs on metal deck.

- E. The minimum compressive strength measured 28 days after placement (f'c), minimum cementitious content, slump, maximum water/cementitious content ratio (W/C), and air content of the concrete for each portion of the structure shall be as follows:
 - 1. Class 1. Controlled Low Strength Material CLSM (Flowable fill). Provide blend of cement, flyash, and sand with minimum cementitious content as follows:
 - a. Excavatable flowable fill: 100 lb cement and 250 lb fly ash per cubic yard.
 - b. Structural flowable fill (250 psi): 175 lb cement and 200 lb fly ash per cubic yard. Add CLSM performance additive at manufacturer's recommended dosage rate, adjusting water content to provide desired flow and strength characteristics.
 - 2. Class 2. Lean Concrete Backfill and Mudmats. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 1,500 psi.
 - b. Minimum Cementitious Material: 200 lbs/cy.
 - c. Slump Limit: N/A.
 - d. Air Content: Natural.
 - 3. Class **3**. Footings. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 3,000 psi.
 - b. Minimum Cementitious Material: 470 lbs/cy.
 - c. Maximum W/C Ratio: 0.50.
 - d. Slump Limit: Minimum of 4 inches and maximum of 6 inches, plus or minus 1 inch.
 - e. Air Content: Natural.
 - 4. Class **5**. Piers and Walls. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 4,500 psi.
 - b. Minimum Cementitious Material: 550 lbs/cy.
 - c. Maximum W/C Ratio: 0.48.
 - d. Water Reducing Admixture: Optional.
 - e. Slump Limit: Maximum 4 inches or 8 inches after adding admixture to 2-to-3-inch slump concrete, plus or minus 1 inch.
 - f. Air Content: Natural.
 - 5. Class **6**. Interior Slab on Grade, Slab on Deck, and Equipment Bases for non-polished surfaces. Normal-weight concrete.
 - a. Minimum Design Compressive Strength: 4,500 psi.
 - b. Minimum Cementitious Material: 550 lbs/cy.
 - c. Maximum W/C Ratio: 0.48.
 - d. Water Reducing Admixture: Mandatory.
 - e. Slump Limit: Maximum 8 inches after adding water reducing admixture to 2-to-3-inch slump concrete, plus or minus 1 inch.
 - f. Air Content: Maximum 3 percent.
 - 6. Class **9**. Exterior horizontal concrete exposed to weather or deicer chemicals, horizontal concrete under roof but in open structures, and exterior equipment bases. Normal-weight concrete.
 - a. Minimum Compressive Strength: 5,000 psi.
 - b. Minimum Cementitious Material: 564 lbs/cy.
 - c. Maximum W/C Ratio: 0.40.

- d. Water Reducing Admixture: Optional.
- e. Slump Limit: 4 inches or not more than 8 inches after adding admixture to 2-to-3-inch slump concrete, plus or minus 1 inch.
- f. Air Content: 5.5 percent for 1 ½-inch maximum aggregate.
 - 6.0 percent for 1-inch maximum aggregate.
 - 6.0 percent for ¾-inch maximum aggregate.
 - 7.0 percent for ½-inch maximum aggregate.
- F. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

2.8 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of correct size, shape, lines, alignment, elevation, position, level, plumb, and dimension and indicated. Maintain formwork construction tolerances and surface irregularities within limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

- 1. Class A, 1/8 inch tolerances for smooth-formed concrete surfaces exposed to view.
- Class D tolerances for earth formed foundation elements. Tolerance applies as a variation inward towards reinforcing only. No tolerance limit away from reinforcing applies.
- 3. Class C, ½ inch tolerances for other concrete surfaces.
- D. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspections where interior area of formwork is inaccessible before and during concrete placement. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Form openings, chases, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, and other features required in the Work. Chamfer exposed corners and edges at exterior corners and edges of permanently exposed concrete and as indicated, to produce uniform smooth, straight lines and tight edge joints.
- I. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- J. Earthen forms may be used for footings and foundation elements when ground is stable and capable of resisting erosion and fluid pressure of wet concrete without sloughing. All tolerances and clear covers shall be maintained. Excavation shall be clean of all loose soil and mud along bottom and sides.
- K. Use selected materials to obtain required finishes.
- L. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
 - 1. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed.
 - 2. Do not spray reinforcing with form oil.
 - 3. Coat steel forms with a nonstaining, rust-preventative material. Do not use rust-stained steel form-facing material.

3.3 INSTALLING EMBEDDED ITEMS

A. Place and secure anchorage devices, anchor rods, and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting

drawings, diagrams, templates, instructions, and directions furnished with items to be embedded.

- 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303. Column anchor rods shall be set in a rigid template and securely braced to formwork or ground prior to placing concrete. Anchor rods shall not be "wet set" in plastic concrete.
- 2. Aluminum conduit shall not be installed in concrete.

3.4 REMOVING AND REUSING FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete must first be sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations shall be maintained.
 - 1. Remove forms only if shores and other vertical supports have been arranged to permit removal without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent as specified for new formwork.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets.
 - Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with Concrete Reinforcing Steel Institute's (CRSI) "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Deliver reinforcement to job site bundled, tagged and marked. Use waterproof tags indicating bar size, length, and mark corresponding to placing drawings.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- D. When permitted, field bend bars cold, except during cold weather when moderate heating is necessary to avoid brittle failures.
- E. Install reinforcing to mechanical splices in accordance with the manufacturer's requirements.
- F. Accurately position, support, and secure all bar reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum coverages as indicated for concrete protection.
 - 1. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
 - 2. Walls with reinforcing mats on each face shall have bent U-bar spacers tied to each mat to hold spacing between mats. U-bar spacers shall be minimum #3 bars spaced

- a maximum of 6 feet on center horizontally and vertically with a row of bars placed at the top of any wall over 4 feet tall.
- 3. All walls shall have chairs or bolsters placed between reinforcing mat(s) and both form faces spaced a maximum of 6 feet on center to maintain clear cover.
- G. Install welded- wire fabric reinforcement in longest practicable lengths on fabric supports spaced to minimize sagging. Lap edges and ends of adjoining pieces at least one full mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace outermost cross wires of lace splices with wire to prevent lifting of the ends during concrete placement.
 - Chair welded wire fabric slab reinforcement with continuous chairs spaced a
 maximum of 32 inches on center. Provide additional chairs as required. Lift welded
 wire fabric back into position between chairs where depressed during concrete
 placement. Lifting welded wire fabric into position during concrete placement without
 the use of chairs is not permitted.
- H. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- I. Construction tolerances shall be in accordance with ACI 117 and the following:
 - 1. For member depths 12" and smaller, tolerance on concrete cover shall be the smaller of -3/8" and -(1/3)*[specified cover].
 - 2. For member depths larger than 12", tolerance on concrete cover shall be the smaller of -1/2" and -(1/3)*[specified cover].
 - 3. At formed soffits, tolerance on concrete cover shall be -1/4".
 - 4. Tolerance for longitudinal location of bends and ends of reinforcement:
 - a. At discontinuous ends of brackets and corbels, ±1/2".
 - b. At discontinuous ends of other members, ±1".
 - c. At other locations, ±2".

3.6 PLACING ADHESIVE SYSTEM

- A. General: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Holes may be dry, damp or wet. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
 - Drill holes with rotary impact hammer drills using carbide-tipped bits and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 - 2. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Acrylic Adhesive Anchors shall not be installed in core drilled holes.
 - Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling.
 - 4. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.
 - 5. Perform anchor installation in accordance with manufacturer instructions.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints in Reinforced Structure and Foundations: Locate and install construction joints so they do not impair strength or appearance of the structure, at locations indicated or otherwise as acceptable to Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form continuous keyways as indicated. Embed keys at least 1-1/2 inches into concrete. Provide keyways 1/3 the member thickness, or 3 ½" minimum, in walls, footings, and between walls and footings centered in the member thickness unless shown otherwise. Provide keyways ½ member width by ½ member depth in grade beams, beams, and columns and between grade beams / beams and supporting members centered in the member unless shown otherwise.
 - 3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Construction Joints in Slab on Grade: Provide slip dowels (as shown on drawings) for construction joints in field of slabs on grade less than 6" thickness. Provide continuous keyways at least 1 1/2 inches deep by 1 ½" wide or slip dowels (as shown on drawings) in construction joints in slabs on grade 6" or thicker. Provide continuous keyways at least 1 1/2 inches deep by one third the slab thickness centered in the construction joint of all formed concrete slabs.
 - Bulkheads designed and accepted for this purpose shall be used for doweled joints.
 Use manufactured plastic sleeves as indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint for non-sleeved dowels.
 - 2. Prefabricated pourstop with keyway may be used for simultaneous placement of adjacent slab panel at Contractor's option, where approved by Architect. Use leave-in-place joint system that is compatible with floor finish or treatment system.
 - 3. Where construction joints at doorways that align with both faces of bearing wall are specified, utilize preformed pourstop with keyway in lieu of slip dowels.
 - 4. Where joints will be exposed to view in public spaces or warehousing areas, joints shall be straight, crisp, and with sharp edges. Slabs shall be flush across joint.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips flush with top of slab to prevent contact or bonding between the slab and the adjoining member. Use strips with perforated strips that remove the top portion to be not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
 - 4. At locations where drawings do not specifically call for premolded filler, provide bond breaker between slab and vertical surface. The vapor retarder may be turned up and used for this purpose.

- 5. Provide ¼" expansion joint between slab and all door jambs (at end of walls in opening).
- 6. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."
- E. Contraction (Control) Joints in Slabs-on-Grade: Construct weakened-plane contraction joints, sectioning concrete into areas as indicated, and to a depth equal to at least one-fourth depth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groove-tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - 3. Contraction joints may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
 - 4. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
 - 5. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."
- F. Construction Joints in Suspended Slab on Steel Deck: Continue reinforcing continuous through joints with reinforcing fully developed to each side. Bulkheads designed and constructed for this purpose shall be used. Do not end pour without bulkhead or other form.
 - 1. Limit total elevated slab pour to 10,000 sq ft, 150 foot maximum length, and 3:1 maximum length/width aspect ratio where slabs will be covered with carpet or other thin set material capable of bridging over and fully concealing potential shrinkage cracking.
 - 2. Limit total elevated slab pour to 6,500 sq ft, 100 foot maximum length, and 2:1 maximum length/width aspect ratio where slabs will be exposed to view or covered with thin-set covering incapable of bridging shrinkage cracks.
 - Construction joints that parallel secondary steel beams shall be placed near midspan
 of the slab between beams and at the deck span nearest the primary girder end
 support. The primary steel girder partially loaded shall not be included in the initial
 slab placement.
 - 4. Construction joints that parallel primary steel girders and cross secondary steel beams shall be located from the girder centerline a distance equal to one-eighth of the girder span. The primary steel girder shall not be included in the initial slab placement.
- G. Control Joints in Suspended Slab on Deck: Do not install or cut contraction (control) joints in elevated concrete slabs on steel floor deck.
- H. Provide waterstops in construction joints in all basement and retaining walls below grade and as indicated.

3.8 WATERSTOP INSTALLATION

- A. Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Protect exposed waterstops during progress of the Work.
 - 1. Locate waterstop within joint relative to face and reinforcing as per manufacturer's printed instructions. Location varies with manufacturer. Location shown on drawings is diagrammatic only. Do not locate waterstop within shear key.
 - 2. Support and protect exposed waterstops during progress of Work.

- 3. Cut ends square, using a razor knife or circular saw equipped with a carbide tipped blade. Weld splices per manufacturer's recommendations.
- 4. Field-fabricate joints in waterstops according to manufacturer's printed instructions.
- B. Concrete surfaces to receive bonded waterstop shall be reasonably smooth with either a formed or float finish. Where such a concrete surface is scheduled to be rough to facilitate interlocking with the adjacent concrete placement, a 2" wide ribbon of flat surface shall be tooled into the concrete surface to facilitate the proper installation of waterstop. Any irregularities in the concrete surface that would interfere with the waterstop being placed in intimate contact with the concrete surface shall be ground smooth prior to installation.
- C. Install waterstop per manufacturer's recommended installation instructions with primer or adhesive as required.

3.9 VAPOR RETARDER INSTALLATION

- A. Sheet vapor retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions. Place sheeting in position with longest dimension parallel with direction of pour.
 - Extend film fully over slab area to the full perimeter of the slab. Turn film up 2" onto surrounding wall/column/piers/etc. and seal to vertical element with continuous mastic or tack tape capable of adhering to concrete and masonry. Film and tape shall not extend above finished floor.
 - a. At the point of termination, seal vapor retarder to the foundation wall, footing, grade beam or slab itself. Where obstructed by impediments (such as dowels, waterstops, or any other site condition requiring early termination of the vapor retarder), use manufacturer's recommended accessories for such non-standard terminations.
 - 2. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressuresensitive tape.
 - 3. Apply seam tape to a clean and dry film only.
- B. Seal around all penetrations (including all conduit and pipes) through film with manufacturer's recommended mastic or pressure-sensitive tape. Cut slit around penetrations to place initial layer of film.
 - 1. For small penetrations, tape film directly to the penetrating element.
 - 2. For penetrations larger than 2", create collar for penetration of 12" wide by 1 ½ times the penetration's circumference with fingers cut half the width of the film. Wrap the collar around the penetration, tape the collar onto the strip of film, and tape the fingers at each edge/slit to the initial layer of film.
- C. Avoid the use of non-permanent stakes driven through film. If non-permanent stakes are driven through film, repair and seal as recommended by film manufacturer.
- D. Repair damaged areas of film material of similar (or better) permeance, puncture resistance, and tensile strength.

3.10 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified. Concrete delivery tickets shall show:
 - 1. Batch number.
 - 2. Mix by number with cement content in pounds and maximum size aggregate.
 - Admixtures.
 - 4. Air content.
 - 5. Slump.
 - 6. Time dispatched and discharged.
 - 7. Date
 - 8. Contractor.
 - 9. Ready Mix Supplier.
 - 10. Project Name and Address.
 - 11. Volume of Concrete.
- C. Do not add water to the concrete mix during delivery, at Project site, or during placement unless approved by the General Contractor's representative, noted on the delivery ticket with the amount of water, and signed by the General Contractor's representative. The maximum water/cement ratio of an approved mix design shall not be exceeded.
 - 1. When the ambient air temperature is between 80 and 90 degrees Fahrenheit, one (1) gallon of water per cubic yard of concrete may be added at the job site to compensate for water evaporation during transit.
 - 2. When the ambient air temperature exceeds 90 degrees Fahrenheit, two (2) gallons of water per cubic yard of concrete may be added at the job site to compensate for water evaporation during transit.
 - 3. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Crystalline waterproofing additive is added to the concrete at the time of batching. It is important to obtain a homogeneous mixture with the concrete. Do not add dry admixture powder directly to wet mixed concrete as this could cause clumping and thorough dispersion may not occur.
- E. Discharge concrete within 1 ½ hours after water has been added to the cement, unless a longer time has been authorized by the Architect/Engineer. During hot weather or other conditions contributing to a quick stiffening of the concrete, the Architect/Engineer may require discharge in less than 1 ½ hours.
- F. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation. Do not allow concrete to drop more than 5 feet or from a height which allows concrete to fall against reinforcing.
 - Deposit concrete in forms in horizontal layers of depth not to exceed formwork design
 pressures and in a manner to avoid inclined construction joints. Where placement
 consists of several layers, place each layer while preceding layer is still plastic to
 avoid cold joints. Do not subject concrete to any procedure that will cause
 segregation. Deposit concrete as near as possible to the final position to avoid
 segregation.
 - 2. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into

preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

- G. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in proper position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- H. Cold-Weather Placement: When air temperature is expected to fall below 40 degrees Fahrenheit (4 deg C) within the first 72 hours after concrete placement, comply with provisions of ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - When mean daily air temperature is expected to fall below 40 deg F (4 deg C) for more than three successive days after concrete placement, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature at point of placement as follows:
 - a. Not less than 55 deg F (13 deg C) or more than 75 deg F (24 deg C) for concrete sections less than 12 inches in the least dimension (width or thickness).
 - b. Not less than 50 deg F (10 deg C) or more than 70 deg F (21 deg C) for concrete sections 12 inches or greater in the least dimension (width or thickness).
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- I. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305.1 and as specified.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 - 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 - 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.
- J. Pumping Concrete: Grout used to prime a pump shall not be placed in the forms of any concrete exposed to view in the final structure. Concrete shall not be pumped through pipe made of aluminum or aluminum alloys.

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is an as-cast concrete surface having texture imparted by form-facing material used. Repair and patch tie holes, honeycombing over ½ inch in depth, and other defective areas. Remove fins and other projections exceeding ¼ inch in height by rubbing down, chipping, or grinding off.
- B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view in non-public rooms (storage, mechanical rooms, etc.) or to be covered with a coating or covering material applied directly to concrete. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes, honeycombing over ¼" in depth, and other defective areas. Remove fins and other projections exceeding 1/8" in height by rubbing down or grinding off until completely removed and smoothed.
- C. Smooth-Formed Finish / Grout-Cleaned Finish: Provide a smooth-formed / grout-cleaned finish on formed concrete surfaces exposed to view in public spaces and exterior. This is an as-cast concrete surface obtained with selected form-facing material arranged in an orderly and symmetrical manner with a minimum of seams. Special care should be taken to avoid consolidation problems, honeycombing, fins, or projections. Repair and patch tie holes, honeycombing over 1/8" in depth, and other defective areas. Remove fins and other projections exceeding 1/8" in height by rubbing down or grinding off until completely removed and smoothed.
 - 1. Perform grout-cleaned finish immediately after stripping forms and no later than 3 days after initial casting of concrete.
 - 2. Combine 1 part portland cement to 1 part fine sand by volume, and a 50:50 mixture of bonding agent and water. Blend standard portland cement and white portland cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
 - 3. Thoroughly wet concrete surfaces to prevent absorption of water from the grout. Apply grout uniformly to initially coat surfaces and fill small holes. Immediately after applying the grout, float the surface with a cork or other suitable float, scouring the wall vigorously. While the grout is still plastic the surface shall be finished with a sponge rubber float to remove all excess grout. Finishing shall be done at the time when grout will not be pulled from holes or depressions. Next allow the surface to dry thoroughly, then vigorously rub with clean burlap to completely remove any dried grout and so that there is no visible film of grout remaining. The entire cleaning operation for any area must be completed on the day that it is started. Keep damp by fog spray over covered burlap for at least 36 hours after rubbing.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds (thick-set) for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

- 1. Slope surfaces uniformly to drains where required. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
- C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo; and where indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.
 - After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
 - 2. Allow moisture film or sheen to disappear from the floated surface and allow the concrete to harden enough to prevent fine material and water from being worked into the concrete surface. Then begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks and uniform in texture and appearance.
 - 3. Finish surface to specified tolerances for floor flatness and floor levelness measured according to ASTM E 1155. Minimum local values shall be 2/3 of the specified composite F-number. Unless otherwise shown or noted on the drawings, comply with the following table:

| Slabs on Grade and Formed Elevated Concrete Slabs (Shored Construction) | | | |
|---|--------------------------|--|--|
| Composite Flatness F(F) | Composite Levelness F(L) | Typical Use | |
| 20 | 15 | Mechanical rooms, non-public areas, surfaces to receive thick-set tile floors, parking structure slabs | |
| 25 | 20 | Surfaces to receive carpet, light traffic (foot) areas in office and industrial buildings | |
| 35 | 25 | Surfaces to receive thin-set flooring | |

Suspended Slabs on Metal Deck (Unshored Construction). Slabs on metal deck or precast concrete and topping slabs shall be finished level, compensating for the deflection of the deck and structure. Floor levelness criteria apply only to non-sloping, formed surfaces and shall be measured within 72 hours of slab placement.

| 30 N/A Inter | rior slabs on metal deck |
|--------------|--------------------------|
|--------------|--------------------------|

- E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a float finish and then an initial trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom. (Final troweling of the surface prior to applying the fine broom finish is not required.)
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Surface Cleaning: Where concrete surface is to be left exposed or sealed with thin film or penetrating coating, burnish or burn to remove all protruding synthetic fiber reinforcing.
- H. Exposed Concrete Slabs: Slabs exposed to view in the public spaces shall be free of trowel marks and uniform in texture and appearance. Sharply defined low and high spots are prohibited and cause for rejection by Architect. Grinding and patching to correct discrepancies will be prohibited unless acceptable to Architect. Use new, clean blankets and other protections that will not discolor or dull the finish.

3.13 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Coordinate sizes and locations of concrete bases with actual equipment to be provided.
 - Construct concrete bases 3 1/2 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 3. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Finish all mechanical housekeeping pads to a finished tolerance of 1/8" in 10 feet.
- D. Grouting of Column Base Plates: Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces, protect installed materials, and allow to cure.
 - 1. Comply with manufacturer's instructions for proprietary grout materials.

2. Grout shall be installed and cured before any elevated concrete slab supported on said columns are placed and prior to installing structural framing in excess of the third story above.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Compatibility: Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete. Dosage rate and material compatibility of curing compound shall be coordinated with the Polishing Contractor for polished concrete floor systems.
- C. For cold-weather protection during curing, comply with ACI 306.1 and the following:
 - 1. All freshly placed concrete shall be kept from freezing for the following periods:
 - a. 3 days for all concrete with an air entraining admixture.
 - b. 4 days for all concrete without an air entraining admixture.
 - 2. A cumulative curing time of seven days at a minimum surface temperature of 50 degrees F (10 degrees C) shall be provided or until concrete has attained 75% of its design strength. This shall be followed by cooling of concrete in a gradual transition to surrounding conditions. The temperature drop during this period shall not be at a rate exceeding 2 degrees F per hour until the outside or surrounding temperature is reached.
 - 3. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40 degrees F for more than three successive days), take additional precautions as specified in "Cold Weather Concreting" by the American Concrete Institute (ACI Report 306) when placing, curing, monitoring and protecting the fresh concrete.
- D. For hot-weather protection during curing, comply with ACI 301 and the following:
 - When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations. Hot weather is defined as air temperature which exceeds 80 degrees F or any combination of high temperature, low humidity and/or high wind velocity that causes a rate of evaporation in excess of 0.2 pounds per square foot per hour as determined by Figure 2.1.5 of ACI Report 305. Hot weather curing is required if these conditions occur within a 24 hour period after completion of concrete placement.
 - 2. Forms, reinforcing and the air shall be cooled by water fog spraying immediately before placing concrete.
 - 3. Immediately following screeding, protect concrete by applying the specified evaporation retarder in accordance with the recommendations of the manufacturer.
- E. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- F. Formed Surfaces: Cure formed concrete surfaces, including walls, columns, sides and underside of beams, supported slabs, and other similar surfaces, by moisture curing with forms in place for 7 days or until forms are removed. If forms are removed within the first 7 days, continue moisture curing without forms for the balance of the 7 day curing period.

- 1. For vertical surfaces, after the concrete has hardened and while the forms are still in place, the form ties shall be loosened and water shall be applied to run down the inside of the form to keep the concrete wet.
- 2. After formwork has been removed from vertical surfaces, keep surface continuously wet by water spray or water-saturated absorptive cover.
- G. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
 - 1. Cure interior and exterior slab surfaces exposed to deicing salts and slabs where the finish flooring is not compatible with curing compounds by Moisture Curing.
 - 2. Cure slab surfaces to receive hardwood flooring or sports rubber systems by Moisture Curing.
- H. Cure concrete according to ACI 308.1 by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moistureretaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.15 LIQUID FLOOR TREATMENT APPLICATION

- A. General: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than seven days old.

- 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.
- C. Penetrating Concrete Sealer
 - Apply penetrating concrete sealer to all concrete floor surfaces exposed to view in the finished structure.
 - 2. Coverage rate shall be 300 square feet (maximum) per gallon.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Architectural exposed formed and exposed slab surfaces only with specific prior approval by Architect (cutting, grinding, and patching of these surfaces will generally be prohibited).
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water. Use only enough liquid as required for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried.
 - 2. Cut tie rods and bolts flush with the surface and drill out to minimum depth of 1 inch below the surface.
 - 3. Fill through wall tie holes with nonmetallic, shrinkage-resistant grout to within 1 ½" of wall face using a grout bag or other similar means to completely fill the void. Fill any remaining tie hole, including holes from snap-off type form ties, with patching mortar or cone plugs secured in place with bonding agent.
 - 4. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 5. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

- 2. After concrete has cured at least 14 days, correct high areas by grinding smooth (at covered slabs only) any surface defects that would telegraph through applied floor covering system.
- 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
- 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
- 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- 6. Repair defective areas, except random cracks to be covered with covering capable of bridging and concealing crack and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- 7. Repair random cracks to be covered with covering capable of bridging and concealing crack and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- 8. Repair random cracks in exposed architectural concrete slab on grade by fully removing and replacing slab between existing control or construction joints. Drill and install dowel bars between new and existing slab as directed by Engineer.
- 9. Repair random cracks in exposed architectural suspended concrete slab by fully removing and replacing slab as directed by Architect. Slab replacement shall extend to third point of framing infill bay and girder span at composite beam systems.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair methods not specified above may be used, subject to acceptance of Architect.

3.17 QUALITY CONTROL

- A. The Owner will employ an independent testing and inspection agency that meets the requirements of ASTM E329 to perform inspections and tests and to prepare test reports. The agency will monitor concrete quality by means of site and laboratory tests. They will be authorized to reject plastic concrete not conforming to specifications. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 014110 Structural Special Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Test results will be reported in writing to the Architect, Engineer, ready-mix producer and General Contractor within 24 hours after tests.

- 3. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect.
- B. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION

- A. The General Contractor shall provide for protection of exposed slab surfaces both before and after treatment by liquid floor treatments or polishing. General Contractor shall coordinate all other construction activities to ensure slab surfaces are not damaged or stained.
- B. Use protective methods and materials, including temporary covering, recommended in writing by installer's manufacturer.
- C. Do not allow contaminants including acids, oils, resins, etc. to contact surface. Provide continuous scuff-preventing pads covered in lapped and sealed water and oil resistant film.
- D. Do not place any material onto surface that may cause etching, scuffing, chips, or scratches. Provide protection boards below scaffolding legs. Do not allow tracked vehicles on surface.

END OF SECTION 033000

Brown + Kubican, PSC

STRUCTURAL ENGINEERS

CONCRETE MIX DESIGN SUBMITTAL FORM

| | Project: | | | | |
|-------------------|---------------|------------------|---|-----------------|----------------------------|
| (| City, State: | | | | |
| | Contractor: | | | | |
| Concrete (| Contractor: | | | | |
| Mix Desig | n Number: | | | | |
| Concrete Streng | | | | | |
| | | | | | |
| Design Mix Inform | <u>mation</u> | | Cr | neck | |
| | | | _ | ne | |
| | Based on S | Standard Deviati | on Analysis | | |
| Ва | ased on Tria | al Mix Laborator | y Test Data | | |
| Design Characte | eristics | | | | |
| | Density | | pcf | | |
| | Strength | | | 28 days) | |
| | Air | | % | | |
| | Slump | | inche | S | |
| If trial mixes a | | | roportioned to ac er than 5000 psi a | | + 1200 psi |
| <u>Materials</u> | | | | | |
| | Туре | Source | Specific Gravity | Weight (lb.) | Absolute Vol. (cu. ft.) |
| cement | | | , | , | |
| flyash | | | | | |

Water/Cementitious Ratio (W/C) = _______ % (lbs. water /lbs. cementitious)

Total

27.0 cu. ft.

silica fume coarse aggregate fine aggregate water

other (

Admixtures

| Manufacturer | Dosage (oz./cwt) |
|--------------|------------------|
| | |
| | |
| | |
| | |
| | |
| | Manufacturer |

| Slump before high range water reducer | = | inches |
|---------------------------------------|---|--------|
| Slump after high range water reducer | = | inches |

Standard Deviation Analysis (field experience records)

| Number of test cylinders evaluated: | Standard deviation (s): | |
|-------------------------------------|-----------------------------|--|
| k-factor: | | |

| Number of Tests | k |
|-----------------|------|
| 15 | 1.16 |
| 20 | 1.08 |
| 25 | 1.03 |
| ≥30 | 1.00 |

| Required avg. | compressive | strength | (≤5000 | psi: Max | [f'c + | 1.34ks, | f'c + 2.33 ks | – 500]) |
|---------------|-------------|----------|--------|----------|--------|---------|---------------|----------------|
| | | | | | | | | |

| (>! | 5000 psi: Max [f'c + 1.34ks, 0.9f'c + 2.3 | 3ks]): |
|-----|---|--------|
| | | |

Actual avg. compressive strength:

(refer to ACI 301 for standard deviation calculation – attach copies of laboratory test reports)

Trial Mix Laboratory Test Data

| | Mix #1 (w | v/c=) | Mix #2 (w | //c=) | Mix #3 (w | //c=) |
|--------------------|-----------|-------------------------|-----------|-------------------------|-----------|-------------------------|
| Age | Date | Compressive Strength | Date | Compressive Strength | Date | Compressive Strength |
| 7 days | | psi | | psi | | psi |
| 7 days | | psi | | psi | | psi |
| 28 days | | psi | | psi | | psi |
| 28 days | | psi | | psi | | psi |
| 28 days average | NA | psi | NA | psi | NA | psi |

(refer to ACI 301 for trial mix procedure – attach copies of laboratory test reports)

Required Attachments

| | Please check |
|---|--------------|
| Coarse aggregate gradation report | |
| Fine aggregate gradation report | |
| Laboratory test reports (strength tests) | |
| Admixture compatibility certification letters | |

| | Ready | y Mix | Sup | plier |
|--|-------|-------|-----|-------|
|--|-------|-------|-----|-------|

| Name and Address: | | | |
|-------------------|---------------------|-------|--|
| | | | |
| Phone: | Miles from project: | Date: | |

SECTION 042000 - UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Clay facing brick.
 - 1. Salvage existing for reinstallation.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Accessories.
- G. Masonry Cleaners.
- H. Products installed, but not furnished, under this Section include the following:
 - Steel lintels for unit masonry, furnished under Division 5 Section "Structural Steel Framing".
 - 2. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section " Steel Doors and Frames".
 - 3. Wood nailers and blocking built into unit masonry are specified in Division 6 " Rough Carpentry".

1.02 RELATED REQUIREMENTS

- A. Section 061000 Rough Carpentry: Nailing strips built into masonry.
- B. Section 072100 Thermal Insulation: Insulation for cavity spaces.
- Section 078400 Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- D. Section 079005 Joint Sealers: Backing rod and sealant at control and expansion joints.
- E. Section 081113 Hollow Metal Doors and Frames: Frame anchoring requirements.

1.03 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ACI 530.1/ASCE 6/TMS 602 Specification For Masonry Structures; American Concrete Institute International; 2008.
- C. ASTM A82/A82M Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- D. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- F. ASTM A641/A641M Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- G. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.

- H. ASTM C56 Standard Specification for Structural Clay Nonloadbearing Tile; 2013.
- ASTM C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile;
 2014.
- J. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- K. ASTM C91/C91M Standard Specification for Masonry Cement; 2012.
- L. ASTM C129 Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.
- M. ASTM C144 Standard Specification for Aggregate for Masonry Mortar; 2011.
- N. ASTM C150/C150M Standard Specification for Portland Cement; 2015.
- O. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- P. ASTM C216 Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- Q. ASTM C270 Standard Specification for Mortar for Unit Masonry; 2014a.
- R. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- S. ASTM C 1019 Standard Test Method for Sampling and Testing Grout; 2009.
- T. BIA Technical Notes No. 7 Water Penetration Resistance Design and Detailing; 2005.
- U. BIA Techical Notes No. 28B Brick Veneer/Steel Stud Walls; 2005.
- V. BIA Technical Notes No. 46 Maintenance of Brick Masonry; 2005.
- W. BIA Technical Notes No. 7 Water Penetration Resistance Design and Detailing; 2005.
- X. BIA Technical Notes No. 28B Brick Veneer/Steel Stud Walls; 2005.
- Y. BIA Technical Notes No. 46 Maintenance of Brick Masonry; 2005.
- Z. ASTM E 119 Standard Test Methods for Fire tests of Building Construction and materials.
- AA. Brick Industry Association: Technical Notes on Brick Construction; Current Edition.
- AB. IMIAWC (CW) Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- AC. IMIAWC (HW) Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.
- AD. UL (FRD) Fire Resistance Directory; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings" and adhere to the following specifics regarding masonry pre-installation conference guidelines.
 - 1. The General Contractor/Construction Manager should organize and hold a meeting with the Owner, Architect, General Contractor/Construction Manager, site superintendent, masonry company owner, masonry foreman, all bricklayers, carriers and any other

personnel from the masonry company that will be working at the project site. Also include testing and inspection agency representative, installers of cavity wall insulation, storefront, curtain wall, door and window, installers of steel, joist and deck, installers of mechanical, electrical and plumbing items, installers of other work in and around the masonry that must precede or follow masonry work.

- 2. Review foreseeable methods and procedures related to masonry work, including but not necessarily limited to the following:
 - a. a)Sample and Mock-up Wall Sections:
 - 1) Size and Location
 - 2) Products and Detail required
 - 3) Protection Methods of Sample and Mock-up Wall Sections
 - 4) Approval Authority and Notification
 - b. Site Inspection:
 - 1) Identity of Responsible Person
 - 2) Frequency of Inspection
 - c. Materials:
 - 1) Storage & Protection
 - 2) Delivery Process
 - d. Submittals:
 - 1) Product Certification
 - 2) Shop Drawing Requirements
 - 3) Time Expectation
 - 4) Testing and Inspection Requirements
 - e. Construction Means and Methods:
 - 1) Hot & Cold Weather Protection
 - 2) Protection of Work in Process
 - 3) Material Handling Process
 - 4) Cleaning Process
 - f. Schedule:
 - 1) Product Availability
 - 2) Review of Associated Trades Responsibility
 - g. Project Closeout:
 - 1) Punch List Procedure
- 3. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.05 FIELD REQUIREMENTS

- A. Protection of Masonry: During construction, cover tops of walls, projections and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry is completed in advance of other wythes, secure cover a of 24 inches down face next to unobstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over wall surface.

- 2. Protect sills, ledges and projections from mortar droppings.
- 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
- 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and as specified herein.
 - 1. Cold Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
 - 2. Hot Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
 - a. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.
 - 3. Cold Weather Construction: When the ambient temperature is within the limits indicated, perform the following construction procedures. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 100 F.
 - a. 40o F to 32o F:
 - 1) Mortar: Heat sand or mixing water to produce mortar temperature between 400 F and 1200 F at time of mixing.
 - 2) Grout: Grout does not require heated materials, unless the temperature of materials is below 320 F.
 - 3) 32o F to 25o F:
 - (a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40o F and 120o F; maintain temperature of mortar on boards above freezing.
 - (b) Grout: Heat grout materials to produce grout temperature between 70oF and 120o F. Maintain grout above 70oF until used in masonry.
 - 4) 25o F to 20o F:
 - (a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40o F and 120o F; maintain temperature of mortar on boards above freezing.
 - (b) Grout: Heat grout materials to produce grout temperature between 40 and 1200 F. Maintain grout above freezing until used in masonry. Heat masonry units to 400 F (40 C) prior to grouting.
 - (c) Heat both sides of walls under construction to 40oF..
 - (d) Use windbreaks or enclosures when wind is in excess of 15 mph.
 - 5) 20o F and below:
 - (a) Mortar: Heat mixing water and sand to produce mortar temperatures between 400 F and 1200 F.
 - (b) Grout: Heat grout materials to produce grout temperature between 70oF and 120o F. Maintain grout above 70oF until used in masonry.
 - (c) Masonry Units: heat masonry units to 40o F.

- (d) Provide enclosure and auxiliary heat on both sides of walls under construction to maintain temperatures within the enclosures above 320 F for a period until mortar sets and water is evaporated from mix to a point that mortar will not spall or lose effective strength due to freezing.
- 4. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
 - a. 40o F to 25o F: Completely cover masonry with weather-resistant membrane for at least 24 hours after construction. Extend coverage time period to 48 hours for grouted masonry.
 - b. 250 F to 200 F: Completely cover masonry with weather-resistive insulating blankets or provide enclosure and heat for 24 hours after construction to prevent freezing. Extend coverage time period to 48 hours for grouted masonry. Install wind breaks when wind velocity exceeds 15 mph.
 - c. 200 F and below: Provide enclosure and heat to maintain temperatures above 320 F within the enclosure for 24 hours after construction. Extend coverage time period to 48 hours for grouted masonry.
- 5. For clay masonry units with initial rates of absorption (suction) which require them to be wetted before laying, comply with the following requirements:
 - a. For units with surface temperatures above 320 F, wet with water heated to above 70 o F.
 - 1) For units with surface temperatures below 320 F, wet with water heated to above 1300 F.

1.06 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- B. Samples for Verification: For the following:
 - 1. Weep holes/vents in color to match mortar color.
 - 2. Accessories embedded in the masonry.
- C. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Each type of masonry unit required.
 - a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
 - 2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 - 3. Each material and grade indicated for reinforcing bars.
 - 4. Each type and size of joint reinforcement.
 - 5. Each type and size of anchor, tie, and metal accessory.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - The Owner will employ an independent agency qualified to perform the testing indicated to verify that the masonry meets the required specification per Chapter 17 of the 2015 International Building Code with KY Amendments. The Owner will be responsible to pay for testing during normal hours of business operation or non-overtime hours. Any testing expense incurred due to overtime work will be paid for by the installing Contractor. The installing Contractor shall notify the testing agency at least 24 hours prior to beginning any work that requires testing. Copies of all reports shall be forwarded to the Owner and Architect.

- 2. Provide continuous inspection to verify compliance of the following:
 - a. Cleanliness of grout space prior to grouting.
 - b. Placement of grout in reinforced cells.
 - c. Preparation of required grout and mortar specimens.
- 3. Provide periodic inspection to verify compliance of the following:
 - a. Proportions of site-prepared mortar or grout.
 - b. Construction of mortar joints.
 - c. Quantity, size, location, and support of reinforcing steel.
 - d. Quantity, size, and placement of horizontal joint reinforcement.
 - e. Type, size and location of anchors.
 - f. Protection of masonry during cold or hot weather
- 4. Verify compressive strength of concrete masonry units, mortar, and coarse grout for every 5,000 sq. ft. of surface area as follows:
 - a. Three (3) concrete masonry units shall be tested in accordance with ASTM C140.
 - b. Six (6) mortar cube specimens shall be tested, three (3) at 7-days and three (3) at 28-days, in accordance with ASTM C109.
 - c. Four (4) coarse grout specimens shall be tested, two (2) at 7-days and two (2) at 28-days, in accordance with ASTM C1019.
 - d. In lieu of individual tests of masonry units, mortar, and grout, perform one (1) prism test (which consists of three prisms) in accordance with ASTM E447.
- B. Fire Rated Assemblies: Conform to applicable code for UL Assembly No. located on the drawings.
- C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, jambs, bonding, sash, and other detailed conditions.
 - a. Provide bullnose units for outside corners, unless otherwise indicated.
 - b. Provide solid units at 45 degree angled corners.
 - 2. Size (Width): Manufactured to the following dimensions:
 - a. 6 inches, 5 5/8" actual.
 - b. 8 inches, 7 5/8" actual.
 - c. 12 inches, 11 5/8" actual.
 - d. Standard units to have nominal face dimension of 8" x 16" unless otherwise indicated
 - 3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi, but as required to achieve the compressive strength of masonry specified in the structural drawings.
 - 4. Non-Load-Bearing and Load-Bearing Units: ASTM C 90, lightweight.
 - a. Hollow block, as indicated.
 - b. Exposed Faces: Manufacturer's standard color and texture where indicated.
 - 5. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - a. A. C. Krebs Company
 - b. Lee Building Products/Meade Block & Stone/Hinkle Block and Masonry; www.leebp.com
 - c. Reading Rock; www.readingrock.com
 - d. Boyle Block/L. Thorn Company; www.boyleblock.com
 - e. Oberfields LLC; www.oberfields.com
 - f. Wright Concrete and Construction: www.wrightconcrete.com

2.02 MORTAR AND GROUT MATERIALS

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - Standard mortars:
 - a. The Quikrete Companies/Spec Mix Inc.: www.specmix.com
 - b. Cemex; Kosmos Cement: www.cemex.com
 - c. Heidelberg Cement Group; Lehigh Hanson/Essroc; Brixment:: www.lehighhanson.com
- B. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction.
 - 1. Not more than 0.60 percent alkali.
 - 2. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
- D. Ready-Mixed Mortar: Materials, water and aggregate complying with requirements specified in this article, combined with set controlling admixtures to produce a ready-mixed mortar complying with ASTM C 270.
- E. Mortar Aggregate: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

- 1. Type as required for mortar to match color mortar selected.
- F. Water: Clean and potable.

2.03 GROUT MATERIALS

- A. Aggregate for Grout: ASTM C 404.
- B. Grout: ASTM C 476. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
 - 1. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.
- C. Refer to structural sheets for additional grout information.

2.04 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers of Joint Reinforcement and Anchors:
 - 1. Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - a. Heckmann Building Products: www.heckmannbuildingprods.com
 - b. Hohmann & Barnard, Inc (including Dur-O-Wal and Blok-Lok companies): www.h-b.com.
 - c. WIRE-BONDwww.wirebond.com/#sle.
- B. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420) deformed billet bars; uncoated. Refer to structural drawings for sizes, spacing and placement.
- C. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard #220 Ladder Type.
 - b. Hohmann & Barnard #120 Truss Type.
- D. Strap Anchors: Bent steel shapes configured as required for specific situations, 1-1/4 in width, 0.105 in thick, lengths as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face, corrugated for embedment in masonry joint, hot dip galvanized to ASTM A 153/A 153M, Class B.
- E. Partition Anchors: Load Bearing to Load Bearing Wall Connection: Steel, ASTM A 366; ASTM A 36, 3/16 inch or greater, hot dip galvanized after fabrication to ASTM A 153/153M, Class B. Anchor to be 1/4 inch thickness, 1-1/2 inch width.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard #344 Rigid Partition Anchor.
- F. Wall Ties: Non-Load Bearing to Non-Load Bearing and Non-Load Bearing to Load Bearing Wall Connection: Steel, ASTM A 366; ASTM A 36, 3/16 inch or greater, hot dip galvanized after fabrication to ASTM A 153/153M, Class B. Mesh to be 1/2 inch square x 16 gage..
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard #MWT Mesh Wall Tie.

- G. Masonry Veneer Anchors for Metal Stud Walls with Rigid Thermal Insulation Board and Masonry Veneer: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 - 3. Vertical adjustment: Not less than 3-1/2 inches.
 - 4. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard X-Seal Anchor and X-Seal Tape..
- H. Joint Stabilizing Anchors: Dur-O-Wal DA2200 or equivalent.
- I. Grout Screen Stop: Dur-O-Wal grout screen stop or equivalent.
- J. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations: Headed Bolts.

2.05 FLASHINGS

- A. Rubberized Asphalt Flashing: Self-adhering polymer-modified asphalt sheet; 40 mil minimum total thickness; with cross-linked polyethylene top and bottom surfaces, 18 inch wide roll minimum.
 - 1. For flashing not exposed to the exterior.
 - 2. Due to the UV sensitivity of flexible flashings all flashings, after installation, must be permanently covered within a reasonable amount of time, not to exceed 30 days.
 - a. Product is not to be installed where it would be exposed to sunlight.
 - 3. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - a. Grace Construction; Product Perm-A-Barrier.
 - b. Hohmann & Barnard; Product Textroflash.
 - c. Dayton Superior; Product Dur-O-Wal.
 - d. IPCO Illinois Products Corporation; Product Self-Adhesive Rubberized Asphalt Flashing: www.illinoisproducts.com
 - e. Mortar-Net USA: www.mortarnet.com
 - f. Advanced Building Products; Product Strip-n- Flash: www.advancedflashing.com
 - g. DuPont: Product Thru-Wall Flashing: www.Construction.Tyvek.com
 - h. BASF: Product Enershield TWF: www.enershield.basf.com
 - i. Wire Bond: Product Aqua Flash 500: www.wirebond.com
 - j. York Flashings: www.yorkmfg.com
- B. Additional flashing system components:
 - Primer, adhesives and seam tape: Provide materials as required by the manufacturer for proper adhesion on the cmu, bituminous dampproofing, fiberglass faced gypsum sheathing, or other substrate.
 - 2. Thru-Wall Flashing Support/Cavity Bridge: "L" shaped, type 304, 27 gauge stainless steel cavity bridge to provide positive support of self-adhered flexible thru-wall flashing across cavity openings. Size to specified cavity wall thickness. Secure to substrate with fasteners through pre-drilled holes.
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:

- 1) IPCO Illinois Products Corporation; Product Type "L" Cavity Bridge: www.illinoisproducts.com
- C. Flashing Bracket: Contractor's option to use flashing bracket system above openings at exterior metal stud and sheathing walls to receive sprayed-in-place thermal insulation.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Flash Track Systems, Inc.: Products Flash Trac Wall Bracket, Retaining Rod, External & Internal Corner Returns, and Alignment Clips: www.flashtracsystems.com
 - 2. After exterior sheathing has been installed, install flashing brackets continuously along all horizontal locations to receive flashing, using self-tapping fasteners compatible with the sheathing/studs.
 - 3. Install flexible flashing after all sprayed-in-place thermal insulation has been applied.

2.06 ACCESSORIES

- A. Compressible Filler: Cut to fit or premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, EPDM, or PVC.
 - 1. Install at tops of non-rated, non-load-bearing CMU walls running perpendicular or parallel to the metal deck. Place a bead of caulk 1/2 inch back from flute opening and on all sides of flute. Compress plug and slide into place.
 - a. Perpendicular to metal deck: Williams Products Inc. EVA 200G or 3000 Series Closure Flute Plugs or Strips: www.williamsproducts.net.
 - Closed Cell plugs and strips per ASTM D-1171, ASTM D-925, ASTM D-412. Density: 12.8 lbs/ft
- B. Bond Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type 1 (No. 15 asphalt felt.)
- C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, thickness sized to fit the wall cavity air space, height to be minimum 10 inches, and design to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - 1) Advanced Building Products IncMortar Break: www.advancedflashing.com.
 - 2) Hohmann & Barnard, Inc: Mortar Trap: www.h-b.com
 - 3) IPCO Illinois Products Corporation; Product Mortar Grab: www.illinoisproducts.com
 - 4) Keene Building Envelope Products: KeeneStone Cut: www.keenebuilding.com
 - 5) MasonPro, Inc; ProNet: www.masonpro.com
 - 6) Mortar Net USA, LtdWallDefender: www.mortarnet.com.
 - 7) Archovations, Inc; Cavelear Masonry Mat.
 - 8) Sandell Manufacturing/Hohmann & Barnard Company; Mortar Web: www.h-b.com
 - 9) Mason Pro; ProNet: www.masonpro.com
 - 10) Wire Bond: Cavity Net DT: www.wirebond.com
- D. Weeps: Polyethylene tubing. Contractors option to use either cotton rope or polyethylene tubing.

E. Type: Molded PVC grilles, insect resistant.

- 1. Provide polyester mesh or cellular, honeycomb polypropylene cavity vents.
 - a. Size: 3/8" x 2 1/2" x 3 5/8".
 - b. Vents to be impervious to water and resistant to UV degradation.
 - Color: Architect to select from manufacturers standard color choices. Minimum six colors.

2.07 MASONRY CLEANERS

- A. Cleaning Solution: Consult with brick manufacturer for recommended cleaning procedure and products. Masonry Contractor to match the cleaning method and cleaning solution to the type of brick and type of stain.
 - 1. Prepared solutions: Non-acidic, low odor, water-rinsable solution for use in the final clean up of new masonry.
 - a. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - Carlisle Coatings and Waterproofing: SimpleKleen Heavy Duty: www.carlisleccw.com
 - 2) Diedrich Technologies: 202 New Masonry Detergent: www.diedrichtechnologies.com
 - 3) EaCoChem; NMD 80: www.eacochem.com
 - 4) Miracle Sealants Company: Liquid Poultice: www.miraclesealants.com
 - 5) Price Research Limited: Price Non-Acidic Masonry Cleaner: www.priceresearchltd.com
 - 6) Prosoco: Safety Klean: www.prosoco.com

2.08 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
 - 1. Extended Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above at contractor's option.
 - 2. Limit cementitious materials in mortar to portland cement and lime.
 - 3. Loadbearing concrete masonry units below grade and in contact with earth: Type M.
 - 4. Loadbearing concrete masonry units above grade: Type S.
 - 5. Exterior, non-loadbearing masonry veneer units: Type N.
 - 6. Interior, loadbearing concrete masonry units: Type S.
 - 7. Interior, non-loadbearing concrete masonry units: Type N.
 - 8. Interior, non-loadbearing masonry veneer units: Type N.
- B. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
- D. Brick Units:
 - 1. Bond: Running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.
- E. Cut joints flush for masonry walls to be concealed or to receive plaster or other direct applied finishes (other than paint), unless indicated otherwise.
- F. Walls to receive ceramic wall tile shall have flush struck joints. Any wall found to be unacceptable by the ceramic tile installer will be corrected to meet specified tolerances.

3.04 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.05 WEEPS AND CAVITY VENTS

- A. Install weeps in vertical head joints in exterior veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and above windows, doors, louvers or any other horizontal obstruction of the cavity wall.
- B. Install cavity vents in vertical head joints in exterior veneer and cavity walls at 24 inches on center horizontally above and below shelf angles, above lintels, near tops of walls (coordinate top of wall location with coping/fascia or other roof edge covering) and above all openings with through-wall flashing. Also install at the bottom of any seat, screen and/or retaining walls without through-wall flashing.
- C. Weeps and cavity vents to be alternated at 24 inches on center.

- D. Depending on weep material used:
 - 1. Install cotton wicking through masonry veneer face and turn 8 to 10 inches up, into the cavity, above the height of any mortar droppings. Secure cotton wicking to substrate without penetrating any through wall flashing membrane. Trim cotton wicking material used in weep holes flush with outside face of wall after mortar has set.
 - 2. Install plastic tubes at an angle in the head joint mortar. Remove plastic tubes used in weep holes from wall after mortar has set.

3.06 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.
- D. Coat cavity face of backup wythe to comply with Division 7 Section "Bituminous Dampproofing".

3.07 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, and CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Reinforce joint corners and intersections with strap anchors 16 inches on center.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.08 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
 - 1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing reinforcement: Refer to Division 5 sections for requirements.

3.09 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches.

3.10 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- F. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.11 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of openings.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches horizontally and 16 inches vertically.

3.12 MASONRY THROUGH-WALL FLASHINGS

- A. Install through wall flashing above metal step flashings and reglets, shelf angles and lintels, at bottoms of walls, and above windows, doors, louvers or any other horizontal obstruction of the exterior cavity wall.
- B. Whether or not specifically indicated, install masonry through wall flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- C. Extend flashing to the face of the masonry veneer.
- D. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.13 LINTELS

- A. Refer to structural drawings for lintel sizes and additional requirements.
- B. Install loose steel lintels over openings.

- C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
- D. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block size units are shown without structural steel or other supporting lintels.
- E. Provide minimum bearing of 8 inches at each jamb, unless indicated otherwise.

3.14 GROUTED COMPONENTS

- A. Refer to the structural specifications and drawings for additional requirements on grouted masonry.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.
- D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.
- E. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
 - 1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.15 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Form expansion joint as detailed on drawings.

3.16 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.
- E. Install reglets and nailers for flashing and other related construction where they are shown to be built in to masonry.

3.17 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- H. Maximum Variation for exposed head joints thickness: 1/8 inch.
- I. Maximum Variation for vertical alignment of exposed head joints: 1/4 inch in 10 feet.
- J. Maximum Variation for exposed bed joints thickness: 1/8 inch.
- K. Maximum Variation for conspicuous horizontal lines: 1/4 inch in 20 feet.
- L. Maximum Variation for conspicuous vertical lines: 1/4 inch in 20 feet

3.18 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.19 FIELD QUALITY CONTROL

An independent testing agency will perform field quality control tests, as specified in Section 014000
 Quality Requirements.

3.20 REPAIRING AND POINTING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. prepare joints for sealant application.
- C. Damaged or chipped concrete masonry units that do not meet the requirements of ASTM C90 for the concrete masonry unit should not be installed. Repair chips, cracks, and other surface damage when visible as viewed in normal lighting conditions at 20 feet. If units incur damage during installation or by other trades, patching of the units shall be with materials compatible with the concrete mix provided in the concrete masonry unit. Provide a finished patch surface texture similar in texture to the concrete masonry unit face being repaired. Do not provide a smooth texture that will result in highlighting the patch when the final paint coats have cured. Patching and repair should be undetectable. Masonry patching by the general contractor, gypsum drywall, painting, or other subcontractor with an incompatible repair product will not be approved.

3.21 IN-PROGRESS CLEANING

- A. Remove excess mortar and mortar droppings. Clean masonry work as the work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Replace defective mortar. Match adjacent work.

3.22 FINAL CLEANING

- A. Comply with guidelines in Brick Industry Association Technical Note #20 Cleaning Brickwork.
- B. Remove excess mortar and mortar droppings.
- C. Replace defective mortar. Match adjacent work.

- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations. Remove large mortar particles by hand with wooden paddles.
- F. Test cleaning methods on mock-up wall panel; leave one half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with final cleaning of masonry.
- G. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
- H. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
- I. Clean brick by bucket and brush hand cleaning method or by pressure sprayer using lowest possible pressure for effective cleaning, as described in BIA Technical Note #20.
- J. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces. Dry brush walls at the end of each day's work and after final pointing to remove mortar spots and droppings.

3.23 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 042000

SECTION 051000 - STRUCTURAL ANCHORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes post-installed metal anchors in concrete, masonry, and steel, as shown on drawings including schedules, notes, and details showing size and location of anchors, typical connections, and types of anchors required.
 - 1. Adhesive anchors.
 - 2. Wedge anchors.
 - 3. Powder actuated fasteners.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - Division 1 Section "Structural Special Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 4 Section "Unit Masonry."
 - 4. Division 5 Section "Structural Steel Framing."

1.3 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product Data for each type of product specified. Include manufacturer's specifications, load charts, and other data to show compliance with the specifications (including specified standards).

1.4 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Installer Qualifications and Procedures: Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.
- C. ICC ES Evaluation Reports/Certificates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Anchors shall be installed by an installer with at least 1 year of experience performing installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Certifications: Unless otherwise authorized by the Engineer, anchors shall have an ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver anchors to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Protect anchors and packaged materials from erosion and deterioration.
- C. Keep anchors, rod materials, nuts and washers in original manufacturer's packaging with label intact until needed for use
- D. Store all anchoring products in strict accordance with manufacturer's recommendations. For adhesive anchors, consider temperature, exposure to sunlight, and shelf life.

1.7 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 FASTENERS AND HARDWARE

- A. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, noncoated.
- B. Carbon Steel Threaded Rod: ASTM A36 or ASTM A193 Grade B7.
- C. Wedge Anchors: ASTM A510 or ASTM A108.
- D. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
- E. Stainless Steel Nuts: ASTM F594.

2.2 ADHESIVE ANCHORS

- A. Cartridge Injection Acrylic Adhesive Anchors: two-component material consisting of acrylic resin, hardener, cement and water, suitable for use on dry or damp surfaces. For use in concrete. Anchor to be approved for use with cracked concrete per ICC-ES AC308.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. HIT HY 200 with HAS Super (ASTM A193 Gr B7) or HIT-Z (AISI 1038 Grade 75) threaded rods, Hilti.
 - b. AC200+ (ICC-ES ESR 4027). DeWalt/Powers.
 - 2. ASTM A563 heavy hex carbon-steel nuts; ASTM F436 hardened carbon-steel washers; and ASTM A36 plate washers.

2.3 MECHANICAL ANCHORS

- A. General: Anchor length shall be as necessary to provide the appropriate projection for the material that is being connected, the washer and full (100% of depth) engagement of the nut, and specified embedment. Embedment depth shall be respective to face of substrate (not attached material). See structural drawings for required minimum embedment of mechanical anchors; where no embedment is specified, provide anchors of sufficient length to result in manufacturer's maximum recommended effective embedment depth.
- B. Basis of design: Structural anchors have been designed using Hilti products as basis of design. Where alternative anchors are substituted which are manufacturer rated as a weaker product for the given application, even when listed as an approved available product, contractor shall decrease member spacing (thereby increasing quantity of anchors) by a proportional amount as part of the base bid.
- C. Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage and wedge dimples to prevent spinning during installation, complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC ES AC193. Type and size as indicated on Drawings. Suitable for fastening into cored, damp, or wet holes. For use in concrete. Anchor to be approved for use with cracked concrete per AC193.
 - 1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ASTM A510 or ASTM A108 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
 - 2. Exterior Use (Including within masonry veneer cavity): Unless otherwise indicated on the drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 - 3. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - Hilti Kwik Bolt TZ2 (Carbon)
 - b. Hilti Kwik Bolt TZ2 (304 Stainless Steel).

2.4 POWDER ACTUATED FASTENERS

- A. Drive Pins: Modified AISI 1060, 1062, or 1070 steel, hardness 49-61 Rockwell C, minimum tensile strength of 282 ksi, and minimum shear strength of 162 ksi; with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5μm min.) unless noted otherwise.
 - 1. For fastening light gauge metal to steel: Minimum 0.157" shank diameter, 3/4" long, with knurled shank and premounted plastic & steel washer.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1) X-U 19 P8 by Hilti.
 - 2) No. 50203 by DeWalt/ Powers Fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

- Drill holes with rotary impact hammer drills using carbide-tipped bits and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface. Drill hole to the specified nominal embedment plus additional length as specified by the Anchor Manufacturer.
- 2. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Acrylic Adhesive Anchors shall not be installed in core drilled holes.
- 3. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
- 4. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- 5. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.
- 6. Perform anchor installation in accordance with manufacturer instructions.

B. Cartridge Injection Adhesive Anchors:

- 1. Adhesive anchors shall be installed in concrete having a minimum age of 21 days at time of anchor installation.
- 2. Prepare all holes per manufacturer instructions by cleaning to remove loose material and drilling dust prior to installation of adhesive. Systems specifically manufactured and tested to allow installation in unclean holes, such as the "Safe Set" system by Hilti, are permitted only after notification and approval by Engineer of Record.
- 3. Holes shall be dry or damp. Wet holes may be acceptable only after notification and approval by Engineer or Record and with use of adhesive suitable for wet conditions.
- 4. Follow manufacturer recommendations to ensure proper mixing of adhesive components.
- 5. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- 6. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface.
- 7. Remove excess adhesive from the surface.
- 8. Shim anchors with suitable device to center the anchor in the hole.
- 9. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

C. Wedge Anchors:

- 1. **Prepare all holes per manufacturer instructions** by cleaning to remove loose material and drilling dust prior to installation of anchor.
- 2. Protect threads from damage during anchor installation.
- Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened.
- 4. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is

not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

D. Powder Actuated Fasteners: Perform anchor installation in accordance with manufacturer instructions. Adjust fastener shank diameter and length to achieve manufacturer's minimum recommended penetration of base material.

3.2 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 014110 Structural Special Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where structural anchors are being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
- B. Correct deficiencies in or remove and replace anchors that inspections and test reports indicate do not comply with specified requirements.

END OF SECTION 051000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.
 - Structural steel is that work defined in American Institute of Steel Construction (AISC)
 "Code of Standard Practice" and as otherwise shown on drawings.
 - 2. Furnish loose lintels and loose beam bearing plates in structural and non-structural walls.
 - Furnish and install shear connectors.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Structural Special Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 4 Section "Unit Masonry."
 - 4. Division 5 Section "Architecturally Exposed Structural Steel Framing."
 - 5. Division 9 Section "Painting."

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PERFORMANCE REQUIREMENTS

- A. Detail structural steel connections required by the Contract Documents to be selected by the fabricator to withstand design loadings indicated.
 - 1. Select and complete connections using typical details provided.

1.6 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Shop Drawings detailing fabrication and erection of structural steel components.
 - 1. Submit a schedule of shop drawing submittal dates which allows the Architect reasonable time for review. Schedule shall list size and approximate number of sheets in each submittal. Provide a plan of the proposed quantity and sequences. Schedule and plan shall be submitted for comment prior to beginning shop drawing preparation.
 - 2. Piecemarks in any given sequence shall be combined such that identical pieces are submitted for review as a single mark/detail. Submittals that submit identical pieces as multiple marks will be rejected unless fabricator compensates engineer for time and materials of shop drawing review.
 - 3. Shop drawings that show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - 4. Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form and pay a handling fee of \$50.00 per drawing prior to receiving the drawing files. Rules for use of said files shall be as defined in the AISC "Code of Standard Practice for Steel Buildings and Bridges," Section 4.3
 - 5. Provide setting drawings, templates, and directions for installation of anchor rods and other anchorages. Provide electronic (AutoCAD) drawing of anchor rods and other embedments to Contractor/Construction Manager for use in preparing a final survey of embedments.
 - 6. Provide erection details of all field connections.
 - 7. Include details of cuts, connections, splices, camber, holes, and other pertinent data in accordance with AISC Specifications and the AISC "Detailing for Steel Construction," latest edition.
 - 8. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Where CJP or PJP welds are to be used, show complete weld symbol with prequalified type and joint designation. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 9. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, tensioned shear/bearing, or blind expansion bolted connections.
 - 10. Include erection plans and details. Note any cutting and/or welding required to be performed in the field.
 - 11. Include ASTM material specifications and grade of steel.
 - 12. Indicate surface preparation for primer/coating/fireproofing and shop primer/coating to be used.
 - 13. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.
- C. Shop Drawings detailing fabrication and placement of loose lintels. Loose lintels in non-bearing walls and over minor openings in structural walls are not shown on the structural plans but are to be included over all openings over 16" in width shown on architectural and mechanical drawings per the lintel schedule in the structural General Notes.
 - 1. Include erection plans showing location and width of all openings.
 - 2. Include details of cuts, connections, stud anchors, slip rods, holes, and other pertinent data in accordance with AISC Specifications and the AISC "Detailing for Steel Construction." latest edition.
 - Indicate welds by standard AWS symbols, and show size, length, and type of each weld.

- 4. Include ASTM material specifications and grade of steel.
- 5. Indicate surface preparation for primer/galvanizing and coating to be used.
- 6. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.

1.7 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
 - 1. Structural steel, including chemical and physical properties.
 - 2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 3. Direct-tension indicators.
 - 4. Twist-off tension control assembly.
 - 5. Shear stud connectors.
 - 6. Weld filler materials.
- D. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification. Provide continuity log for each welder, signed by the employer, showing that the welder has engaged in the necessary processes of welding during each 6 month period since the qualification. In lieu of qualification tests and continuity log, submit AWS CW number.
- E. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code Steel," for each welded joint qualified by testing, including the power source (constant current or constant voltage).
- F. Fabricators who participate in the certified Quality Certification Program shall submit, at the completion of fabrication, a certificate of compliance stating that the work was performed in accordance with the approved construction documents.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
 - 1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified *Standard for Steel Building Structures (STD)* Plant.
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 360 "Specification for Structural Steel Buildings."

- 2. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
- AISC 341 "Seismic Provisions for Structural Steel Buildings."
- 4. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- 5. American Welding Society's (AWS) D1.1-2004 "Structural Welding Code Steel."
- 6. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
- 7. AGA American Galvanizers Association publication "Recommended Details for Galvanized Structures".
- 8. AISC Steel Construction Manual, 14th Edition.
- 9. AWS "AWS Standard for Certification AWS Certified Welders" AWS QC7-93.
- 10. SSPC Steel Structures Painting Manual, Vol. 2 Systems and Specifications; Steel Structures Painting Council; 1995, Seventh Edition.
- 11. SSPC-VIS 1-89 Visual Standard for Abrasive Blast Cleaned Steel; Steel Structures Painting Council; 1989.
- 12. SSPC-VIS 3 Visual Standard for Power and Hand Tool Cleaned Steel; Steel Structures Painting Council; 1993.
- D. Welding Qualifications and Standards: Qualify procedures and personnel in accordance with applicable provisions of AWS D1.1 "Structural Welding Code Steel" and AISC 360.
 - 1. All shop and field welding shall be performed by personnel qualified by AWS procedure and who have engaged in the necessary processes of welding during each six month period since the latest qualification.
 - 2. Fabricator and erector shall institute a *Welder Identification System* wherein the welder who has welded a joint or member can be identified.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
 - 1. The Contractor shall require reasonable representatives of every party who are concerned with the steel work to attend the Conference, including but not limited to, the following:
 - a. Contractor's Superintendent Structural Steel Fabricator Structural Steel Installer Testing and Inspection Agency Structural Engineer.
 - 2. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by them to all parties concerned within five days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes:

 Owner's Representative and Architect.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

- C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL MATERIALS

- A. All structural steel shapes shall be new, unused and perfect stock, free from millscale, rust, flake, pitting, and imperfections, without bends, kinks, and distortions. Shop splicing of members will only be permitted if the member exceeds maximum mill length.
- B. Wide Flange and Tee Shapes (Designated as W, M, S, HP, WT, MT and ST): ASTM A992.
- C. Channels, Angles, Plates and Bars: ASTM A572, Grade 50.
- D. Cold-Formed Structural Steel Sections (Round, Rectangular, and Square Tubing): ASTM A500, Grade C.
- E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. General: For clarity in distinguishing between medium carbon steel (A325) bolts and alloy steel (A490) bolts, the structural drawings and this specification classify bolts using generic A325 and A490 designations. Contractor shall provide tension indicating device assemblies, as opposed to ordinary bolts, as required in the bolt specification below.
- B. Medium Carbon Steel High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy hex steel structural bolts; ASTM A563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers, uncoated. Use ordinary bolts, washers, and nuts only where required for installation access, where bolts are called to be galvanized, and at contractor's option for snug-tight installation applications.
 - 1. Finish: Plain, uncoated, except where indicated to be galvanized.
 - 2. Galvanized Finish: Hot-dip zinc-coating, ASTM A153, Class C or mechanically deposited zinc-coating, ASTM B695, Class 50. Use galvanized bolts for all steel to be painted with zinc-rich primer, unless noted otherwise, and elsewhere as noted on drawings.
 - 3. Twist-Off-Type Tension-Control Bolt-Nut-Washer Assemblies: ASTM F1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers. Use of twist-off-type tension-control assembly is mandatory except where bolts are allowed by structural drawings to be installed snug-tight, where installation access prohibits use, and where bolts are called to be galvanized. Use of galvanized twist-off type assemblies is not permitted.

- C. Anchor Rods, Bolts, Nuts, and Washers: As follows:
 - Non-High Strength Rods (Hooked, Straight, Headed, or Threaded): ASTM F1554 Grade 36.
 - 2. Nuts: ASTM A563 heavy-hex carbon-steel.
 - 3. Plate Washers: ASTM A36 carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
- D. Shear Connectors: ASTM A108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B. Dimensions shall comply with AISC Specifications.

2.3 PRIMER

- A. Primer for uncoated steel: Fast-drying, low VOC, lead- and chromate-free, non-asphaltic, rust-inhibiting primer. Primer to be formulated for application over SSPC SP2 or SP3 prepared surfaces.
- B. Primer for coated steel: Fast-drying, low VOC, high-build and high-solids, lead- and chromate-free, non-asphaltic, rust-inhibiting primer. Primer to be compatible with topcoat(s) including, but not limited to, intumescent coatings, alkyd, acrylic, and high performance coatings such as epoxy and polyurethane. Primer to be formulated for application over SSPC SP6 prepared surfaces and selected by coating manufacturer for suitability and compatibility.
- C. Zinc Rich Primer: SSPC-Paint 20 (79% minimum zinc dust in dried film).
 - 1. Use inorganic Ethyl Silicate binder. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. Carbozinc 11, Carboline Company, Inc.
 - b. Tneme Zinc 90E-92, Tnemec Company, Inc.
 - c. Zinc Clad II, Sherwin Williams Co.
 - d.

2.4 GALVANIZING MATERIALS

- A. Galvanizing: The zinc used for the coating shall conform to the specifications for slab zinc (Spelter) ASTM designation: B6.
- B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds and repair painting of galvanized steel, with dry film containing not less than 93 percent zinc dust by weight and complying with DOD-P-21035 A or SSPC-Paint 20, Type II.

2.5 ASPHALTIC COATING

- A. High build, polyamide epoxy coal tar coating suitable for use over bare or primed structural steel- SSPC 16.
 - 1. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. TarGuard, Sherwin Williams Co.

2.6 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," AISC 360, and other specifications referenced in this Section and in Shop Drawings.
 - 1. Mark and match-mark materials for field assembly.
 - 2. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 - 3. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 4. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Fabricate steel exposed to view with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 - 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
 - 2. Fabricate and erect to AESS standards as outlined on the plans.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.
- F. Holes: Provide holes required for securing other work to structural steel framing, for attaching structural steel connections and embeds to other work, and for passage of other work through steel framing members, as shown on Shop Drawings.
 - 1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
 - Weld threaded nuts to framing and other specialty items as indicated to receive other work.
 - 3. Provide erection holes, of minimum 3/16" diameter, in steel embed plates for temporary fastening of embeds to concrete formwork. Provide minimum 4 holes per piece. Coordinate hole size, spacing, and layout requirements with other trades contractors.
 - 4. Provide vent and drain holes in closed sections subject to galvanizing or condensation due to exposure to thermal fluctuations.
- G. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
- H. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."
- 2.7 SHOP CONNECTIONS

- A. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. Bolts: ASTM A325 (ASTM A325M) high-strength bolts, unless otherwise indicated.
 - 2. Connection Type: Unless snug tight connections are noted on the drawings as being permitted, all bolts shall be tightened to full pretensioning load. Bolts shall be pretensioned in a systematical progression from the most rigid point of the connections toward the free edges.
- B. When two structural members on opposite sides of a column web, or a beam web over a column, share common connection holes do not use connections that require either member to be completely disconnected (nuts removed from bolts) for installation of the succeeding member.
- C. Do not reuse bolts that have been tensioned.
- D. All bolts of same ASTM type shall be of same diameter. In addition, bolts of different ASTM type shall be of different diameter unless otherwise approved by Structural Engineer.
- E. Install blind expansion bolts in accordance with the bolt manufacturer written installation procedures. Verify required installation torque of each is achieved.
- F. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work. Remove all cracks, pores, slag inclusions, incomplete fusions, and incomplete penetrations over ½" long in any weld and reweld.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - 2. Furnish all steel members in one piece without splicing, unless otherwise noted on project drawings or approved by Structural Engineer.
 - 3. Design of Members and Connections: Typical AISC connections are to be used except where otherwise shown. Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.
- G. Where Drawings indicate spliced and/or bent beams, provide AWS D1.1 pre-qualified full penetration welds to develop 100% of the beam's shear and moment capacity.
- H. Connections incorporating any of the following shall be marked with an identifying mark painted on the member.
 - 1. Connections using bolts larger than ¾ inches.
 - 2. Bearing connections with bolt threads excluded from shear plane.

2.8 SURFACE PREPARATION FOR COATINGS

- A. Steel fabricator shall coordinate fireproofing and finishing requirements with architectural documents.
- B. Surface Preparation: Clean surfaces to be painted. Remove dirt, loose rust, loose mill scale, and spatter, slag, or flux deposits. Wipe steel surfaces with solvent to remove rolling oils that impair primer bond. Prepare surfaces according to SSPC specifications as follows:
 - 1. SSPC-SP 1 "Solvent Cleaning," all galvanized steel, unless noted otherwise.

- 2. SSPC-SP 2 "Hand Tool Cleaning," all steel except as otherwise specified.
- 3. SSPC-SP 3 "Power Tool Cleaning."
- 4. SSPC-SP 5 "White Metal Blast Cleaning."
- 5. SSPC-SP 6 "Commercial Blast Cleaning," all steel to receive zinc rich primer in the field or intumescent fireproofing. Remove all mill scale. Blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils).
- 6. SSPC-SP 8 "Pickling."
- 7. SSPC-SP 10 "Near-White Blast Cleaning," all steel to receive zinc rich primer in the shop. Remove all mill scale.
- 8. SSPC-SP 11 "Power Tool Cleaning to Bare Metal."
- 9. SSPC-SP16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals," all galvanized steel to be painted.

2.9 SHOP PRIMING

- A. General: Structural steel shall not be exposed to open atmospheric conditions between surface preparation and priming. Priming operation shall be performed in continuous operation with surface preparation.
 - 1. Prime any blast-cleaned, bare steel within 8 hours of surface preparation or before flash rusting occurs.
- B. Shop prime steel surfaces, except the following:
 - 1. Surfaces to be field welded.
 - Galvanized surfaces.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

D. Zinc Rich Primer

- 1. Exposed exterior structural steel for the terrace structure shall be prime painted with the specified Zinc Rich Primer.
- 2. Prepare surfaces to be painted with inorganic binder primer according to Steel Structures Painting Council Specification SSPC-10.. The Pictorial Surface Preparation Standards for Painting Steel Surfaces, SSPC-VIS 1-89, shall be the acceptance criteria for the degree of preparation for cleaned surfaces.
- 3. Contractor shall photograph blast cleaned structural steel members prior to priming and submit photographs to Engineer as confirmation that steel was properly cleaned.

E. Application

1. Steel to be exposed to view in the finished structure shall have primer applied by spraying or smooth nap roller.

2.10 GALVANIZING

A. All welded assemblies to be galvanized shall be prepared according to Recommended Practice for Providing High Quality Zinc Coatings (Hot-Dip) on Assembled Products (ASTM A385).

- B. Steel shall be hot-dip galvanized in accordance with ASTM A123 except that galvanized steel to be finish painted shall not be quenched (including by water, chromate, oil, or other deleterious substance). Coating weight shall conform with paragraph 5.1 of ASTM A123.
- C. Hardware and threaded fasteners shall be galvanized in accordance with ASTM A153. Coating weight shall conform with Table 1 of ASTM A153.
- D. Safeguard products against steel embrittlement according to ASTM A143.
- E. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.
- F. Surface finish shall be continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
- G. Adhesion shall withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base, Bearing, and Leveling Plates: Clean concrete and masonry bearing surfaces of bondreducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Column base plate anchor rods shall not be repaired, replaced, or field modified without the approval of the Structural Engineer. Prior to erection of a column the Contractor shall provide written notification to the Erector if there has been any repair, replacement or modification to its anchor rods.
 - 2. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

- 3. Snug-tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
- 4. Weld plate washers all around to top of baseplate with minimum, unless otherwise noted, AISC permitted fillet weld size for thickness of parts joined at all braced frame and moment frame columns.
- 5. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
 - b. Grout shall be installed and cured before any elevated concrete slab supported on said columns are placed and prior to installing structural framing in excess of the third story above.
- C. Maintain erection tolerances of structural steel within AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless specifically approved by the Engineer.
- G. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Provide all bracing, temporary bracing and accessories required for complete erection. Safety and adequacy of bracing and temporary bracing are the Installer's responsibility.
- I. After erection, remove weld flux, rust, dirt or other foreign material from areas to receive touch-up paint. Repaint areas where protective coating has been damaged or is missing with shop primer paint.
- J. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors for composite construction in field, spaced as shown to beams and girders. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions. Break off and remove insulators after stud installation. Remove insulators from composite deck prior to placing concrete.
- K. Deformed Bar Reinforcing: Prepare steel surfaces as recommended by manufacturer of weldable reinforcing. Use automatic end welding of rebar where length adaptors for welding equipment are available; otherwise, provide continuous fillet weld all around size to develop full yield strength of rebar.
- 3.4 FIELD CONNECTIONS

- A. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. Bolts: ASTM A325 (ASTM A325M) high-strength bolts, unless otherwise indicated.
 - 2. Connection Type: Unless snug tight connections are noted on the Drawings as being permitted, all bolts shall be tightened to full pretensioning load.
- B. Do not reuse ASTM A490 bolts, galvanized A325 bolts or bolts that have been tensioned.
- C. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding. Remove all cracks, pores, slag inclusions, incomplete fusions, and incomplete penetrations over ½" long in any weld and reweld.
 - 1. Comply with AISC 303 and AISC 360 for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - 4. The General Contractor shall provide a full-time trained Fire-Watch Captain with appropriate fire suppression equipment during all times that welding activities occur and a minimum of 30 minutes thereafter. This person shall be in addition to the workmen.
- D. Remove all erection clips, gussets, bolts, and angles where exposed in the finished structure and where they interfere with other construction. Grind welds smooth where exposed.

3.5 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 014110 Structural Special Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where structural steel work is being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, Steel Fabricator and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Touchup Priming: Immediately after erection, clean field welds, bolted connections, abraded areas of shop primer, and exposed areas where primer is damaged or missing. Apply primer

using same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.

- 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning for standard primers and SSPC-SP6 Commercial Blast Cleaning for zinc-rich primers.
- Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).
- B. Coordination with Other Trades: Cleaning and primer touch up/repair that may be required as a result of, but not limited to, the following are not included in the scope of this specification section and are included to be included under Division 9 Section "Painting."
 - Abrasions and rust from: bundling, banding, loading and unloading, chains, dunnage, cables and chains during erection, bridging, installation, and other jobsite handling.
 - 2. Bolt heads and nuts.
 - Dirt.
 - 4. Diesel smoke.
 - 5. Road salt.
 - 6. Weather conditions during storage and construction.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780. Minimum thickness requirements for the repair are those described in ASTM A123, Section 4.6.
- D. Asphaltic Coating: After erection clean column base plates, anchor rod nuts, columns and other structural steel below grade up to finished floor. Clean bare steel surfaces to remove loose rust, loose mill scale, and spatter, slag, or flux deposits in accordance with SSPC-SP 2 "Hand Tool Cleaning." Clean primed steel to be free of dirt and moisture. Apply coating by brush or spray to provide a minimum dry film thickness of 10 mils on rods, nuts, and structural steel up to bottom of slab on grade. Do not extend coating above grade.

3.7 CLEANING

A. All bare, primed, or galvanized steel to be left unpainted shall be thoroughly cleaned by solvent cleaning in accordance with latest edition of Steel Structures Painting Council Surface Preparation Specification No. 1 (SSPC-SP1). Hydrocarbon based solvents are prohibited.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Steel roof deck.
 - 2. Noncomposite steel form deck.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - Division 1 Section "Structural Special Inspection."
 - 2. Division 3 Section "Cast-in-Place Concrete."
 - 3. Division 5 Section "Structural Steel Framing."
 - 4. Division 9 Section "Painting."

1.3 ACTION SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product data including manufacturer's specifications and installation instructions for each type of deck, accessory, and product specified.
- C. Shop drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.
 - 1. Shop drawings which show the Architect's or Engineer's title block, logo and/or seal will be rejected and returned unchecked.
 - Computer generated electronic structural construction document files (ACAD) will be made available to the Contractor. The Contractor will be required to sign the Engineer's standard release of liability form prior to receiving the drawing files. Rules for use of said files shall be as defined in the AISC "Code of Standard Practice for Steel Buildings and Bridges," Section 4.3.
 - 3. Shop drawing resubmittals are reviewed for conformance with review marks only. Any changes or questions originating on a resubmittal shall be clearly clouded.

1.4 INFORMATIONAL SUBMITTALS

- A. General: Furnish submittals in quantity, format, and other Conditions of the Contract and as specified in Division 1 of the Project Manual.
- B. Product certificates signed by manufacturers of steel deck certifying that their products comply with specified requirements.

C. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise indicated.
 - 1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members."
 - 2. American Welding Society (AWS), D1.3 "Structural Welding Code Sheet Steel".
 - 3. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks."
- B. Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code Steel" and AWS D1.3 "Structural Welding Code Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that my be incorporated in the Work include, but are not limited to, the following:
 - 1. American Buildings Co.
 - 2. Epic Metals Corp.
 - 3. Marlyn Steel Products, Inc.
 - 4. New Millennium Building Systems, LLC.
 - 5. Robertson A United Dominion Co.
 - 6. Roof Deck, Inc.
 - 7. United Steel Deck, Inc.
 - 8. Verco Manufacturing Co.
 - 9. Vulcraft Div. Of Nucor Corp.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:
 - Galvanized-Steel Sheet: ASTM A 446, Grade A, G 60 zinc coated according to ASTM A 653.
 - 2. Deck Profile: Type WR, wide rib.
 - 3. Profile Depth: as indicated on drawings.

- 4. Design Uncoated-Steel Thickness: 0.0358 inch.
- 5. Span Condition: As indicated on drawings.
- 6. Side Joints: nested.

2.3 FORM DECK

- A. Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet noncomposite form deck panels conforming to SDI Publication No. 28 "Specifications and Commentary for Noncomposite Steel Form Deck," the minimum section properties indicated, and the following:
 - Galvanized-Steel Sheet: ASTM A 446, Grade E, G 60 zinc coated according to ASTM A 653.
 - 2. Profile Depth: As indicated on drawings.
 - 3. Design Uncoated-Steel Thickness: As indicated on drawings.
 - 4. Span Condition: As indicated on drawings.

2.4 ACCESSORIES

- A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.
- B. Mechanical Fasteners: Manufacturer's standard, corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon steel fasteners; or self-drilling, self-threading screws.
- C. Self Drilling Steel Screws: Manufacturer's standard hexagonal washer head, self-drilling, carbon steel screws. Screws shall be zinc electroplated to 5μm (minimum) thickness in accordance with ASTM B633 SC1 Type III. Select point type and size and thread length per manufacturer's recommendations to fully engage in the base material.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Hilti S-MD.
- D. Powder or Pneumatic Fasteners: Modified AISI 1070 steel, minimum hardness 54 Rockwell C, minimum tensile strength of 285 ksi, and minimum shear strength of 175 ksi; with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5μm min.). Fasteners shall have knurled shanks, forged ballistic point, and minimum 12 mm steel washers for bar joists and 15 mm steel washers for structural steel.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Bar Joist and Structural Steel with thickness of 1/8" up to and including 3/8": Hilti X-HSN 24.
 - b. Structural Steel 1/4" or thicker: Hilti X-ENP-19 L15.
- E. Miscellaneous Roof Deck Accessories: Steel sheet, 0.0359-inch-thick minimum ridge and valley plates, finish strips, and reinforcing channels, of same material as roof deck.
- F. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile as required per SDI Publication No. 28.

- G. End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.
- H. Weld Washers: Manufacturer's standard uncoated-steel sheet weld washers, shaped to fit deck rib, 0.0598 inch thick with 3/8-inch minimum diameter prepunched hole.
- I. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - 1. ZRC Galvilite, ZRC Worldwide.
- J. Preset Inserts: Manufacturer's standard, UL-labeled single-piece preset inserts, fabricated from either steel sheet galvanized according to ASTM A 653, G 60 coating class, or zinc sheet, with removable covers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 PREPARATION

- A. Do not place deck panels on concrete supporting structure until concrete has cured and is dry.
- B. Locate decking bundles to prevent overloading of supporting members.

3.3 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, and requirements of this Section.
- B. Install temporary shoring before placing deck panels when required to meet deflection limitations.
- C. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.
 - 1. Align cellular deck panels for entire length of run of cells and align cells at ends of abutting panels.
- D. Place deck panels flat and square and fasten to supporting framing without warp or deflection.
- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. All welds sizes stipulated on drawings or specification shall be effective (not visible) diameter/length.
- H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's instructions.
- I. Do not use deck units for storage or working platforms.
- J. Where options in fastening methods are given, fastening method of deck shall be compatible with supporting framing; including consideration for thickness of supporting steel.

3.4 ROOF DECK INSTALLATION

- A. Specified roof deck fastening is unless noted otherwise in the Construction Drawings.
- B. Fasten roof deck panels to steel supporting members as follows:
 - 1. Fasten to structural steel supporting members with self-drilling No. 12- diameter or larger carbon steel screws or powder actuated fasteners at each support.
 - 2. Fastener Spacing: Screw or pin deck units at ends and all intermediate supports. Space fasteners a maximum of 12 inches on center, with a minimum of four fasteners per unit at each support.
- C. Side Lap Fastening: Fasten side laps between supports at intervals not exceeding 36 inches with self-drilling No. 10- diameter or larger carbon steel screws.
- D. Perimeter Edge Fastening:
 - Fasten perimeter edges of deck to steel supporting members and angles with No. 12diameter or larger carbon steel screws or powder actuated fasteners spaced a maximum of 12 inches on center.
- E. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- F. Where layout of deck does not align bottom flute with edge angles / structure for complete perimeter fastening, provide continuous z-plate along deck edge and fasten to structure and deck in accordance with perimeter edge fastening requirements.
- G. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations. Screw to substrate to provide a complete deck installation.

3.5 FORM DECK INSTALLATION

- A. Specified form deck fastening is unless noted otherwise in the Construction Drawings.
- B. Fasten form deck panels to steel supporting members per structural plans.:
- C. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches, with end joints as follows:

- 1. End Joints: Lapped 2 inches minimum.
- D. Pour Stops: Weld steel sheet pour stops to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Form Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck according to SDI recommendations to provide tight-fitting closures at open ends of ribs and sides of decking.

3.6 QUALITY CONTROL

- A. General: The Owner will engage an independent testing and inspecting agency to perform inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements. Failure to detect any defective materials shall not prevent later rejection when such defect is discovered, or obligate the Architect or Owner for final acceptance.
 - 1. See Section 014110 Structural Special Inspections and Contract Drawings for testing and inspection to be performed.
 - 2. Provide access for testing agency to places where steel decking work is being installed so that required inspection and testing can be accomplished.
 - 3. The General Contractor shall provide the testing agency a complete set of approved shop drawings.
 - 4. Reports will be delivered to the Architect, Engineer, Steel Fabricator and the General Contractor within one week of inspection.
 - 5. Deviations from requirements of the contract documents will be reported in writing to the General Contractor within 24 hours.
 - 6. Correct deficiencies in or remove and replace steel deck that inspections and test reports indicate do not comply with specified requirements.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.
- B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.
 - 1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
 - 2. Where shop-painted surfaces are exposed in-service, apply touchup paint to blend into adjacent surfaces.

END OF SECTION 053100

SECTION 055000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated and/or prefabricated steel, and aluminum items, including:
 - 1. loose steel lintels, elevator pit ladder, elevator sump pit cover, and ships's ladder.
 - 2. Steel framing and supports for: mechanical and electrical equipment.
- B. Manufactured items:
 - 1. Ships ladder safety post at roof hatch access.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 042000 UNIT MASONRY: Placement of metal fabrications in masonry.
- C. Section 055213 Pipe and Tube Railings.
- D. Section 077200 Roof Accessories: Roof hatch.
- E. Section 099000 Painting: Final paint finish system for all interior and exterior galanized and/or prime painted items.

1.03 REFERENCE STANDARDS

- A. ANSI A14.3 American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- B. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- D. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- E. ASTM A283/A283M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- F. ASTM A501/A501M Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- G. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- H. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- I. ASTM F3125/F3125M Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- J. AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- K. AWS D1.1/D1.1M Structural Welding Code Steel; 2015.
- L. SSPC-Paint 15 Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- M. SSPC-Paint 20 Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- N. SSPC-SP 2 Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- B. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- C. Submit painting and coating product data.
- D. Structural Design Data: Where installed metal fabrications are indicated or required to comply with certain design loadings, include structural computations, material properties, and other information needed for review of structural analysis. Computations and analysis shall be stamped by a structural engineer licensed to practice in Kentucky.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements.
 Coordinate construction to ensure that actual dimensions correspond to established dimensions.
 Allow for trimming and fitting.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Recycled Content: Provide steel products having a minimum 30% recycled content.
- B. Steel Sections: ASTM A36/A36M.
- C. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- D. Plates: ASTM A283/A283M.
- E. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I Inorganic, complying with VOC limitations of authorities having jurisdiction.
 - 1. Additional acceptable materials: ZRC Worldwide ZRC Galvilite: www.zrcworldwide.com

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 SHOP FABRICATED ITEMS

- A. General: Comply with requirements of ANSI A14.3 American National Standard for Ladder-fixed-safety 1992 and OSHA 29 CFR Standard 1910.27.
- B. Elevator Pit Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; hot dipped galvanized and prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.
 - 1. Location: Elevator shaft.
 - a. Side Rails: 1/2 x 2-1/2 inches plate members spaced at minimum 16 inches.
 - Side rails to extend 48 inches above the landing/finish floor to act as handrails.
 - b. Rungs: one inch diameter solid round bar spaced 12 inches on center.
 - 1) Space rungs a clear distance of not less than 4-1/2 inches from the centerline of the rungs to the nearest permanent object in back of the ladder.
 - 2) First rung 6 inches from top of ladder.
 - 3) Bottom rung 12 inches from floor surface.
 - c. Height: Verify pit depth/finish floor elevation with elevator manufacturer requirements.
 - d. Provide anchorage points, for fasteners, at floor and at ladder mid-point with tabs for anchorage to the wall and floor.
 - 1) Provide appropriate fastener for floor and wall substrate.
 - e. Locate pit ladder within 39 inches of the egress door.
 - f. Provide a metal ladder from each pit floor starting 12" above the pit floor and extending to 48" above the lowest landing floor level.
 - g. Locate the ladder at strike jamb side of hoistway when single panel or two speed doors are used.
 - h. Where center opening doors are used, locate the ladder on the nearest sidewall.
- C. Ship's Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; hot dipped galvanized and prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.
 - 1. Refer to detail on the drawings for sizes of components and requirements.
 - 2. Refer to "Manufactured Items" section below for ships ladder, at the roof hatch, safety post requirements.
- D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- E. Lintels: As detailed; hot dipped galvanized and prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.
- F. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.
- G. Elevator Sump Pit Cover: Refer to structural drawings for sump pit construction. Coordinate size with elevator manufacturer.Refer to Div 9 Painting specification section for final paint system requirements.

1. McNichols, or equivalent, GW Series welded steel bar grating, hot-dipped galvanized 1-1/2 inch x 3/16 inch. Bearing bars 3/16 inch on center and cross bars at 4 inch on center.

2.05 PREFABRICATED ITEMS

- A. Aluminum Ladders: Contractors option in lieu of fabricated steel ladders to provide and install equivalent aluminum ladders.
 - 1. General: Comply with requirements of ANSI A14.3 American National Standard for Ladder-Fixed-Safety 1992 and OSHA 29 CFR Standard 1910.27.
 - a. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1) Precision Ladders, LLC.: www.precisionladders.com
 - 2) ACL Industries, Inc.: www.aclindustries.com
 - 3) Cotterman Co.: www.cotterman.com
 - 4) Royalite Manufacturing, Inc.: www.royalite-mfg.com
 - 5) O'Keeffe's, Inc.: www.okeeffes.com
 - 6) FixFast USA: www.fixfastusa.com
 - 2. Materials:
 - a. Extruded Aluminum Profiles: ASTM B 221/B 221M, ASTM B 210, ASTM B 308/B 308M, Alloy 6061-T6; standard mill finish.
 - b. Aluminum Sheet and Plate: ASTM B 209/B 209M, Alloy 6061-T6; standard mill finish.
 - c. Fasteners: Aluminum solid aircraft rivets rated at 300 lbs (1335 N) shear strength.
 - d. Cast fittings, connectors and rung ends: Cast Aluminum alloy 356.
 - e. Finish: All components to have a mill finish.
 - 3. Ladders:
 - a. Elevator Pit Ladders: Extruded aluminum; Rungs shall withstand a 1,000 pound (454 kg) load without deformation or failure.
 - b. Ships Ladders: Extruded aluminum; Steps shall withstand a 1,000 pound load without deformation or failure.
 - 4. Ships Ladder Safety Post at Roof Hatch:
 - a. Manufacturers Safety Post: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - Basis of Design: Design concept and the drawings indicate the size, profiled, dimensional requirements and aesthetics of the following:
 - (a) Extend-A-Rail for inclined ships ladders: www.precisionladders.com
 - 2) Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - (a) Bilco Co.: www.bilco.com
 - (b) Acudor Products Inc.: www.acudoor.com
 - (c) Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - (d) Precision Ladders, LLC: www.precisionladders.com
 - (e) SafetyPro LP: www.safeprosafety.com
 - 3) Safety Post: Telescoping post permanently anchored to the top rung(s) of each steel and/or aluminum ships ladder(s) being provided.
 - (a) Post to have adjustable mounting hardware to accommodate ladder rung size and spacing.
 - (b) Post to automatically lock in the fully raised position.

- (c) Post to have release lever for lowering.
- (d) Post to be steel with a safety yellow powder coat finish.

2.06 FINISHES - STEEL

- A. Prepare surfaces to be primed in accordance with SSPC-SP2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Prime Painting: One coat.
- D. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.
- E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- F. All steel items to be installed on the exterior of the building are to be galvanized.
- G. Refer to Div 9 Painting specification section for final paint system requirements for all fabricated steel items.

2.07 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.
- D. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior wall mounted handrails and interior handrails that are part of a steel railing system in aluminum.
- B. Interior and exterior stair railings and guardrails in steel.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 099000 Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; 2012.
- B. ASTM B211 Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.
- C. ASTM B241/B241M Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2012.
- D. ASTM B429/B429M Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2010.
- E. ASTM B483/B483M Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications; 2013.
- F. ASTM E935 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.
- G. ASTM E985 Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

1.04 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- B. Submit painting and coating product data.
- C. Structural Design Data: Where installed metal fabrications are indicated or required to comply with certain design loadings, include structural computations, material properties, and other information needed for review of structural analysis. Computations and analysis shall be stamped by a structural engineer licensed to practice in Kentucky.

1.05 QUALITY ASSURANCE

- A. Steel Handrails and Railings:
 - 1. Fabricator Qualifications: Company specializing in assembling and installing the steel pipe and tube railing as indicated on the drawings and specified in this section with a minimum five years documented experience.
- B. Aluminum Handrails:
 - 1. Manufacturer's Qualifications: Company specializing in manufacturing the aluminum handrails specified in this section with a minimum five years documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver railing systems and related components in protective packaging.
 - 1. Upon delivery open cartons and inspect for damage.
 - 2. Maintain material in original packaging until installation.
 - Store components to avoid damage from moisture, abrasion, and other construction activities.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- B. Design railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point without damage or permanent set. Test in accordance with ASTM E 935.
- C. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
 - 1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 - 2. Handrails Not Serving As Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 - 3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
 - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
 - 1. Top Rails and Wall Rails: 1-1/2 inches diameter, nominal round. (1.900 inches Outside Diameter)
 - 2. Intermediate Rails: 1-1/2 inches diameter, nominal round. (1.900 inches Outside Diameter)
 - 3. Posts: 1-1/2 inches diameter, nominal round. (1.900 inches Outside Diameter)
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- G. Exterior Use Grout: Non-shrink Portland cement-based hydraulic grout mixed and applied in accordance with manufacturer's instructions. Gypsum based material is not acceptable.
 - 1. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating.

2.02 ALUMINUM MATERIALS

A. Aluminum Tube for Handrails: Aluminum extrusions; alloy and temper 6063-T4. Minimum wall thickness of 0.127 inch; ASTM B 429/B 429M, ASTM B 241/B 241/M, or ASTM B 483/B 483M.

2.03 STEEL RAILING SYSTEM

- Recycled content: Provide steel products having a minimum 30% recycled content.
- B. Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.
- C. Steel Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- D. Galvanizing: In accordance with requirements of ASTM A123/A123M.
 - 1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I Inorganic.
 - 2. All railings for exterior use are to be galvanized.
- E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.04 FABRICATION - STEEL RAIL

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 - 1. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius. Joint finish to meet NOMMA finish #2.
- E. Expansion Joints in Exterior Rails: Provide slip joint with internal sleeve extending 2 inches beyond joint on each side.
 - 1. Provide for ground/slab mounted or wall mounted railings.
 - 2. Fasten sleeve to one side only.
 - 3. Locate expansion joints to within a minimum of 6 inches to a maximum of 12 inches of a vertical post or handrail bracket.
 - 4. Provide expansion joints at intervals of maximum 20 feet on center.
 - 5. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Wagner Companies: Single Lock Splice-Lock: www.wagnercompanies.com
 - b. Wagner Companies: Aluminum Internal Sleeve: www.wagnercompanies.com

2.05 FABRICATION - ALUMINUM HANDRAIL

- A. Configuration: Size and space members in compliance with applicable codes. All posts shall be unspliced single pipe length. Lower rails shall be a single unspliced length between posts. All top rails shall be continuous.
 - 1. Open tube ends or sections are not allowed.
- B. Fit, shape and assemble components in largest practical sizes, for delivery to job site. Fabricate components with joints tightly fitted and secured.

2.06 ALUMINUM FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.
- D. Sleeve Mounting:
 - 1. Arrange for casting of sleeves or core drill insitu concrete to provide holes for railing uprights.
 - 2. After setting, fill holes with hydraulic grout; brace members until grout is cured.

3.04 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 - For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheathing.
- B. Roof-mounted curbs.
- C. Roofing nailers.
- D. Communications and electrical room mounting boards.
- E. Wood nailers and curbs for roofing and items installed on roof.
- F. Concealed wood blocking, nailers, and supports.
- G. Installation of wood doors and hardware.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Fiber -glass faced gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. AF & PA National Design Specification for Wood Construction. Include supplements.
- B. ALSC American Lumber Standards Committee: Softwood Lumber Standards.
- C. APA PRP-108 Performance Standards and Qualification Policy for Structural-Use Panels (Form E445); 2001.
- D. ASTM D2559 Standard Specification for Adhesives
- E. PS 1 Structural Plywood; 2009.
- F. PS 2 Performance Standard for Wood-Based Structural-Use Panels; 2010.
- G. PS 20 American Softwood Lumber Standard; 2010.
- H. SPIB (GR) Grading Rules; 2014.

1.04 SUBMITTALS

- A. Product Data: Provide technical data on application instructions.
- B. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

- 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
- Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

2.02 DIMENSION LUMBER

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: "Standard" grade light framing size lumber of any species or board-size lumber as required. "Standard" grade boards per WWPA rules or "No. 2 Boards" per SPIB rules.

2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacturer.
 - 1. Where rough carpentry is exposed to weather, in ground contact, in contact with preservative treated lumber, or humidity, provide fasteners with hot dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
 - 2. Nails, Wire, Brads, and Staples: FS FF-N-105.
 - 3. Power Driven Fasteners: National Evaluation Report NER-272.
 - Wood Screws: ANSI B18.6.1.
 - 5. Screws to Cold-Formed Metal Framing: Corrosion-resistant coated, self drilling, self threading steel drill screws with low-profile head.
 - 6. Lag Bolts: ANSI B18.2.1.
 - 7. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.05 METAL FRAMING ANCHORS

- A. General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
 - 1. Current Evaluation/Research Reports: Provide products for which model code evaluation/research reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with the building code in effect for this project.
 - 2. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by qualified independent testing laboratory.

2.06 CONSTRUCTION PANELS

- A. Wall Sheathing: PS 2 type.
 - 1. Bond Classification: Exterior.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 24.
 - 4. Performance Category: 3/4 PERF CAT.
 - 5. Edge Profile: Square edge.
- B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.07 ACCESSORIES

- A. Fasteners and Anchors:
 - For treated lumber, use hot-dip galvanized nails, screws, fasteners, and etc. with a
 minimum coating of G-185 (1.85 oz.) of zinc per square foot of surface area per ASTM
 A653. Contractor option to use stainless steel nails, screws, fasteners, and etc. in type 304
 or 316. Do not use a mix of galvanized and stainless steel products.
 - a. Acceptable hot-dip galvanized products are:
 - 1) Simpson Zmax.
 - 2) USP Structural Connector Triple Zinc.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finishing work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will

receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- Install solid wood grounds, nailers, blocking, and sleepers as required for support of wall and ceiling mounted items.
 - 1. Plywood strips and/or metal strapping will not be accepted as sutiable blocking material.
- B. Contractor option to use a flexible wood backing plate system in lieu of solid wood blocking as specified in this section.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include:
 - a. Clark Dietrich Building Systems Danback Flexible Wood Backing Plate: www.clarkdietrich.com
 - b. Equivalent submitted to Architect prior to issuance of last addendum.
- C. In metal stud walls, provide continuous solid wood blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide solid wood blocking attached to studs as backing and support for wall-mounted items,
- E. Where ceiling-mounting is indicated, provide solid wood blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following non-structural framing and solid wood blocking, but not limited to the following locations:
 - 1. Cabinets, shelf, and countertop supports.
 - 2. Wall mounted cabinets.
 - 3. Wall brackets.
 - 4. Handrails and guardrails.
 - 5. Fire extinguisher cabinets, brackets, and valve cabinets.
 - 6. Grab bars.
 - 7. Toilet and bath accessories.
 - 8. Toilet and urinal partitions.
 - 9. Wall-mounted door hardware and stops.
 - 10. Chalkboards, tackboards, and marker boards.
 - 11. Wall paneling and trim.
 - 12. Joints of rigid wall coverings that occur between studs.
 - 13. Locker base and wall attachment.
 - 14. Interior and exterior wall openings to receive metal frame system; window, door, etc.
 - 15. Access panels.
 - 16. Framed openings.
 - 17. Plumbing fixtures.
 - 18. Ceiling mounted projection screens and projector mounts.
 - 19. Wall mounted projection screens and projector mounts.
 - Wall and ceiling mounted items indicated as N.I.C. and/or Owner provided and Owner installed.

3.03 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

- A. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- B. Coordinate curb installation with installation of decking and support of deck openings.

3.04 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

3.05 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 CLEANING

- A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 064100 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Restroom Vanities
 - 2. Mothers' Room Vanities
 - 3. Food Service serving line counter/front and stainless steel open shelving units
 - 4. Solid surface countertops

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification sections, apply to this Section.
 - 1. Section 016116 Volatile Organic Compound (VOC) Content Restrictions
 - 2. Section 061000 Rough Carpentry: Support framing, grounds, and concealed blocking
 - 3. Division 6 Section "Miscellaneous Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation
 - 4. Section 090050 Finish Legend
 - 5. Section 123550 Institutional Casework (plastic laminate-faced wood cabinets of stock design)

1.03 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.
- B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets. The bottom of wall cabinets are considered exposed and will receive **plastic laminate**.
- C. Semiexposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semiexposed.
- D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.04 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014.
- B. AWI (QCP) Quality Certification Program; current edition at www.awiqcp.org.
- C. AWMAC/WI (NAAWS) North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. BHMA A156.9 American National Standard for Cabinet Hardware; 2010.
- E. NEMA LD 3 High-Pressure Decorative Laminates; 2005.
- F. ANSI A135.4 American National Standard for Basic Hardboard; 2012.
- G. ANSI A208.1 American National Standard for Particleboard; 2009.
- H. ANSI A208.2 American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- I. AWI (QCP) Quality Certification Program; current edition at www.awiqcp.org.
- J. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014.

- K. AWMAC (GIS) Guarantee and Inspection Services Program; current edition at www.awmac.com/gis.php.
- L. BHMA A156.9 American National Standard for Cabinet Hardware; 2010.
- M. HPVA HP-1 American National Standard for Hardwood and Decorative Plywood; 2009.
- N. NEMA LD 3 High-Pressure Decorative Laminates; 2005.

1.05 SUBMITTALS

- A. Samples for Verification: 6-inch- (150-mm-) square Samples for each type of finish, including top material and the following:
 - 1. Section of countertop showing top, front edge, and backsplash construction.
- B. Product Data: For each type of product indicated including cabinet hardware and accessories and finishing materials and processes.
- C. Product Data: For each type of product indicated.
- D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- E. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Plastic laminates.
 - 2. Thermoset decorative overlays.
- F. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.
- G. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.06 **OUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Installer Qualifications: An authorized representative of institutional casework manufacturer for installation and maintenance of units required for this Project.
- D. Source Limitations: Obtain institutional casework through one source from a single manufacturer.
- E. Quality Standard: Build and install to AWI quality.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be sorted in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.09 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware Legend specified in Division 8 Section "Door Hardware (Keyed by Naming Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

1.10 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Delamination of components or other failures of glue bond
 - 2. Warping of components.
 - 3. Failure of operating hardware.
 - 4. Deterioration of finishes.
- B. Warranty Period: Five years from date of Substantial Completion.

1.12 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 WOODWORK FABRICATORS

- A. All manufacturing technic and components must comply with the contract specifications. The designer's selections will not be limited to those plastic laminate selections which are the standards of the casework manufacturer. The plastic laminate selections will be made from the laminate manufacturer(s) full range of colors, patterns and finishes.
- B. Multiple manufacturers of work of this section will not be accepted. Subject to compliance with requirements, interior architectural woodwork by one of the following include:
 - 1. Accents in Wood, Inc.

- 2. Action Outfitters
- 3. Advantage Millwork
- 4. America's Finest Woodworking Team
- 5. Cabinets & Countertops, Inc.
- 6. Caseworks of Kentucky, Inc.
- 7. Corman & Associates, Inc.
- 8. Cowart & Company
- 9. Cumberland Manufacturing
- 10. Custom Creations, Inc.
- 11. Euronique, Inc.
- 12. Interior Wood Specialties
- 13. Kentucky Caseworks
- 14. Kentucky Mill & Casework
- 15. Leininger Cabinets
- 16. Louisville Lumber
- 17. LSI Corporation, Inc.
- 18. Morgan Smith Industries
- 19. Reynolds & Doyle, Inc.
- 20. Riverside Mill
- 21. Smith's Laminating
- 22. Southern Cabinetry, Inc.
- 23. SSC Casework & Millwork
- 24. Stevens Industries, Inc.
- 25. Stidham Cabinets
- 26. Tate Ornamental
- 27. TMi/Trimline
- 28. US Millwork
- 29. Wood Concepts
- 30. Custom cabinetry companies whose products meet or exceed the project specifications as approved by written addendum.
- C. Refer to the drawings for premium laminate and/or decorative metal laminate locations.

2.02 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species for Opaque Finish: Any closed-grain hardwood.
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Hardwood Plywood and Face Veneers: HPVA HP-1.
 - 6. Exposed Plywood: Hardwood plywood, selected for compatible color and grain. Grade AA exposed faces at least 1/50 inch (0.5 mm) thick, and Grade J crossbands. Provide both faces of same species.
 - Semiexposed Plywood: Hardwood plywood of same species as exposed plywood.
 Semiexposed backs of plywood with exposed faces shall be same species as faces. Grade B faces and Grade J crossbands.
- D. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Arborite
 - b. Formica Corporation
 - c. Nevamar
 - d. Wilsonart
- F. Exposed Cabinet Materials:
 - Plastic Laminate: Type VGS.
 - a. Unless otherwise indicated, provide plastic laminate for exposed surfaces.
 - b. Provide plastic laminate for doors and drawer fronts and where indicated.
- G. Semiexposed Cabinet Materials:
 - 1. Plastic Laminate: Type CLS.
 - a. Provide plastic laminate for interior faces of doors and drawer fronts [only/and] where indicated.
 - 2. Melamine-Faced Particleboard: Particleboard with decorative surface of thermally fused, melamine-impregnated web and complying with LMA SAT-1.
 - a. Provide melamine-faced particleboard for semiexposed surfaces, unless otherwise indicated.
- H. Concealed Cabinet Materials:
 - 1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
 - 2. Plywood: Hardwood plywood. Concealed backs of plywood with exposed or semiexposed faces shall be same species as faces.
 - 3. Plastic Laminate: Type BKL.
- I. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Basis of Design: HI-MACS "Moon Haze" G118
 - b. LG Surfaces
 - c. Surell; Formica Corporation
 - 2. Price Group: Based on selections from HI-MACS provide price group equal to "Moon Haze" G118.

2.03 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)." Refer to the drawings for additional hardware components.
- B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112. Shelf standards and supports shall be equal to Knape and Vogt 182 decorative heavy duty bracket and standards.
- D. Shelf Rests: BHMA A156.9, B04013.
- E. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

F. Countertop Support: Provide countertop supports equivalent to Federal Brace: Freedom hidden supports (20x20) brackets, size brackets to suit installation.

2.04 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.05 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide Custom grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.
- E. All wall and base cabinets over 3'-0" in width shall receive a vertical to prevent deflection.

2.06 PLASTIC-LAMINATE CABINETS

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.
- B. Grade: Custom
- C. AWI Type of Cabinet Construction: Flush overlay
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: HGS
 - 2. Postformed Surfaces: HGP
 - 3. Vertical Surfaces: HGS
 - 4. Edges: Self edged plastic laminate
 - 5. Body Front Edging: HGS
- E. Materials for Semiexposed Surfaces: Provide surface materials indicated below:
- F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Solid colors
 - 2. Wood grains
 - 3. Patterns
- G. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

H. Wood grains and/or any laminate with a directional design shall all be applied to the cabinet face in one consistent direction.

2.07 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
- B. Grade: Custom
- C. Solid-Surfacing-Material Thickness: 1/2 inch (13 mm), unless shown otherwise on drawings
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
- E. Fabricate tops in one piece with field-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

2.08 STAINLESS STEEL OPEN BASE CABINETS

- A. Cabinet backs, end panels, uprights, and toe base fabrication from 18 guage stainless steel.
- B. All cabinets shall have a cleanable, smooth interior.
- Front face joints fully welded, ground and polished to provide a continuous flat front plane free of crevices.
- D. Adjustable intermediate shelves fabricated from 20 gauge stainless steel, with front and rear edges formed down and back 3/4". Ends forned down 3/4" for stiffness.

2.09 FINISH FOR WOOD CASEWORK

- A. Preparation: Sand lumber and plywood for institutional casework construction before assembling. Sand edges of doors and drawer fronts and molded shapes with profile-edge sander. Sand casework after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.
- B. Wood Colors and Finishes: Match Architect's samples.
- C. Staining: Remove fibers and dust and apply wash-coat sealer and stain to exposed and semiexposed surfaces as required to provide uniform color and to match approved samples.
- D. Finishing Closed-Grain Woods: Apply manufacturer's standard two-coat, baked, clear finish consisting of a thermosetting catalyzed sealer and a thermosetting catalyzed conversion varnish. Sand and wipe clean between applications of sealer and topcoat. Topcoat may be omitted on concealed surfaces.

2.10 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 2 feet from sink cut-outs.

- 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 PREPARATION

 Condition woodwork to average prevailing humidity conditions in installation areas before installation.

3.03 INSTALLATION

- Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Caulk space between backsplash and wall with clear silicone.
- H. Refer to Division 9 Sections for final finishing of installed architectural woodwork.
- I. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

- J. Use fixture attachments in concealed locations for wall mounted components.
- K. Use concealed joint fasteners to align and secure adjoining cabinet units.
- L. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- M. Secure cabinets to floor using appropriate angles and anchorages.
- N. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.04 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- D. Adjust installed work; test installed work for rigidity and ability to support loads.
- E. Adjust moving or operating parts to function smoothly and correctly.

3.05 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 071300 - UNDERSLAB SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Underslab sheet membrane vapor barrier.
 - Vapor barrier is to be installed beneath the entire interior area of first floor new concrete slab construction.

1.02 RELATED REQUIREMENTS

- A. Section 079005 Joint Sealers: Sealant for joints in substrates.
- B. Section 312323 Fill.
- C. Section 334600 Subdrainage.

1.03 REFERENCE STANDARDS

- A. ASTM D570 Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
- B. ASTM D746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2014.
- C. ASTM D882 Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.
- D. ASTM D1709 Standard Test Method for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- E. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- F. ASTM E154/E154M Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).
- G. ASTM E 1643 Standard Specification For Installation of Plastic Water Vapor Retarder Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- H. ASTM E 1745 Standard Specification For Plastic Water Vapor Retarder Used in Contact with Soil or Granular Fill Under Concrete Slabs - Class A.
- I. NRCA ML104 The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.04 SUBMITTALS

- A. Product Data: Provide data for vapor barrier and sheet waterproofing membranes, tape, sealants and other system components.
- B. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing and vapor barrier for compliance with requirements, based on testing of current waterproofing formulations.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.
- B. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Source Limitations: Obtain products through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid and sheet material to Project site in original packages with seals unbroken, labeled with manufacturers name, product brand name and type, date of manufacture, and directions for storing and mixing other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by manufacturer.
- C. Remove and replace liquid materials that cannot be applied within thief stated shelf life.
- D. Store sheets and rolls according to manufacturers written instructions.
- E. Protect stored materials from direct sunlight.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.
- B. Do not apply to a damp or wet substrate.
- C. Do not apply in snow, rain, fog or mist.

1.08 WARRANTY

- A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by the Installer. covering work of this section, for warranty period of two years.

PART 2 PRODUCTS

2.01 MEMBRANE MATERIALS

- A. CLEAR, OR WHITE, POLYETHYLENE SHEET PLASTIC WILL NOT BE ACCEPTED UNDER ANY CIRCUMSTANCES.
- B. Manufacturers
 - 1. Underslab Vapor Barrier: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) W.R. Meadows, Inc. Perminator 15 mil Class A.
 - b. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.

- 1) Floor Seal Technology, Inc. TruBarrier 15 mil: www.floorseal.com
- 2) Insulation Solutions, Inc; Viper II 15 mil: www.insulation solutions.com
- 3) Inteplast Group: Barrier Bac IntePlus XF VB-350: www.barrierbac.com
- 4) Raven Industries; VaporBlock 15 mil: www.ravenefd.com
- 5) Stego Industries LLC; Stego Wrap 15 mil: www.stegoindustries.com
- 6) Tex-Trude, LP: Xtreme 15 mil: www.tex-trude.com
- 7) W.R. Meadows; Perminator 15 mil: www.wrmeadows.com

C. Product Requirements

- 1. Vapor Barrier: 15 mil vapor retarder.
 - a. Vapor transmission rate: 0.018 or less.
 - b. Puncture resistance: ASTM D1709, Minimum 4000 grams.
 - c. All seams to overlap minimum 6 inches and be taped using manufacturer's recommended products. Seal all penetrations. Turn product up foundation wall thickness of slab. Repair all tears or punctures.

D. Materials

- 1. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - a. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- 2. Joint Sealing Compounds: Low-viscosity, two component, asphalt-modified sealer. All protrusions (pipes, etc.) Shall have a premolded collar surround to be sealed in place.
- 3. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items that penetrate surfaces to receive waterproofing are securely installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.
- E. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

3.03 INSTALLATION - VAPOR BARRIER

- A. Install vapor barrier in accordance with manufacturer's instructions.
- B. Roll out membrane, and minimize wrinkles and bubbles.

- C. Membrane to cover entire pour area.
- D. All vapor barrier joint/seams, both lateral and butt, are to be be overlapped minimum 6 inches and taped using minimum 4 inch wide tape provided by the manufacturer.
 - 1. Tape area of adhesion to be free from dust, dirt and moisture to allow maximum adhesion of tape.
- E. Vapor barrier is to be turned up on all vertical foundation walls the full thickness of the concrete slab on grade. Adhere to the walls with an adhesive provided by the manufacturer of the waterproofing sheet.
- F. Per manufacturers requirements create collars, made from the vapor barrier material, to seal around all pipe, duct, rebar and conduit/wire penetrations. Tape collars completely.
- G. In the event that the vapor barrier is damaged during or after installation, repairs must be made. Cut a pice of vapor barrier material large enough to cover the damage by a minimum overlap of 6 inch in all directions. Clean all adhesive areas and tape.

3.04 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 071300

SECTION 071400 - FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-Applied Waterproofing:
- B. Below-grade waterproofing accessories.
- C. The extent of fluid applied waterproofing includes the face of all below grade walls at the elevator pit.

1.02 RELATED REQUIREMENTS

A. Section 079005 - Joint Sealers: Sealant for joints in substrates.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. AATCC Test Method 30 Antifungal Activity, Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials; 2004.
- C. ASTM C836/C836M Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2012.
- D. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).
- E. ASTM D5385/D5385M Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2014).
- F. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- G. NRCA ML104 The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.04 SUBMITTALS

- A. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants, self stick insulation anchors.
- B. Shop Drawings: Show locations and extent of waterproofing. Indicate details for special joint, crack, penetrations, inside and outside corners, tie-ins with adjoining waterproofing or other termination conditions and conditions of interface with other materials.
- C. Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- H. Product test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.

I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 OUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Waterproofing and Dampproofing Manual.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Source Limitations: Obtain all components that make up the total waterproofing system; waterproofing membrane, protection board and drainage panel, through one source from a single manufacturer.

1.06 PROJECT CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.07 WARRANTY

A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include,
 - 1. Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Waterproofing System based on W.R. Meadows: Mel-Rol LM Waterproofing Membrane, PC-2 Protection Course and Mel-Drain Drainage Panel.
 - 2. Waterproofing system by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - Carlisle Corporation, Carlisle Coatings & Waterproofing Div.; CCW-525, CCW MiraDrain 6000, CCW Protection Board-V: www.carlisle-ccw.com
 - b. W.R. Grace & Co.: www.na.graceconstruction.com
 - c. W. R. Meadows: www.wrmeadows.com
 - d. Mar-FlexWaterproofing & Building Products: www.mar-flex.com
 - e. Pecora Corporation.: www.pecora.com
 - f. Premium Liquid Rubber: www.sprayrubber.com

2.02 SPRAY-ON WATERPROOFING

- A. Physical Properties: As follows, measure per standard test methods referenced:
 - 1. Single component, water based, polymer-modified, cold applied, waterproofing membrane
 - 2. Wet Mil Application Thickness: Coverage rate of 20-25 ft. 2/gallon providing a minimum thickness of 60 wet mils.
 - 3. Dry/Cured Thickness: Minimum 45 mils dry.
 - 4. Color: Brown to Black.
 - 5. Solids: 70%.
 - 6. Total Cure Time: 16-24 hours.

- 7. Shore "00" Hardness, ASTM C836: Passes.
- 8. Adhesion to Concrete, ASTM C836: Exceeds.
- 9. Low Temperature Flex and Crack Bridging, ASTM C836: Passes.
- 10. Stability, ASTM C836:Exceeds.
- 11. Elongation, ASTM D412: + 1000% to 1500%.
- 12. Water Absorption, ASTM D1970: 0.7%.
- 13. Water Vapor Transmission, ASTM E96 (Method B): 0.01 to 0.03 perms/sq. ft.

2.03 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid primer recommended for substrate by manufacturer of waterproofing material.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of waterproofing material.
- D. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as waterproofing.
- E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.
- F. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer for adhesion of the waterproofing, insulation/protection board and drainage panel system.
- G. Self-stick insulation anchors may be used in conjunction with the adhesive system above for securing the insulation/protection board and drainage panels to the wall system.
- H. Protection Courses: Due to differences in manufacturers protection course's the following types are acceptable in the fluid waterproofing total system:
 - Protection Course: (W. R. Meadows system) Semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - a. Thickness: 1/8 inch (3 mm), nominal.
 - b. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.
 - 2. Protection Course: (Carlisle system) Lightweight, high density, rigid, extruded polystyrene foam vertical protection board.

2.04 MOLDED-SHEET DRAINAGE PANELS

- A. Description: Prefabricated, composite drainage panels, made with drainage core and filter fabric, for use as part of foundation drainage system.
- B. Drainage Core: 3-Dimensional, non-biodegradable, molded-plastic-sheet material designed to effectively conduct water to foundation drainage system under maximum soil pressures.
 - 1. Minimum Flow Rate: 15 gpm/foot (3.1 l/s/1000 mm) at one hydraulic gradient and 3600 psf (172 kPa) normal pressure when tested according to ASTM D 4716.
 - 2. Film Backing: Plastic, protective-film, backing sheet attached to surface building wall.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions. Ensure that all bug holes, honeycombing or other concrete imperfections have been repaired and prepared to receive the membrane primer and membrane.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
- D. Seal cracks and joints with sealant using methods recommended by sealant manufacturer.
- E. Install cant strips at inside corners and at base of wall at the footing.

3.03 INSTALLATION

- A. Apply waterproofing in accordance with manufacturer's instructions to specified minimum thickness. A two coat installation is preferred over a single coat installation.
 - 1. Back brush/back drag the coating if it begins to sag or drip.
- B. Conform to NRCA Waterproofing and Dampproofing Manual drawing details.
- C. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- D. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.
- E. At joints from 1/2 to 1 inch in width, loop joint cover sheet down into joint between 1-1/4 and 1-3/4 inch. Extend sheet 6 inches on either side of expansion joint.
- F. Center joint cover sheet over joints. Roll sheet into 1/8 inch coating of waterproofing material. Apply second coat over sheet extending minimum of 6 inches beyond sheet edges.
- G. Apply waterproofing in accordance with manufacturer's instructions to specified minimum thickness.
- H. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 6 inches at subsequent plies laid in shingle fashion.
- Apply extra thickness of waterproofing material at corners, intersections, and angles.
- J. Extend waterproofing 12-inches across the top of the footing.
- K. Extend waterproofing across the brick ledge and up the face of wall to the elevation of the thru-wall flashing.
- L. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- M. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE PANEL and PROTECTION BOARD

- A. After the membrane has cured, place insulation/protection board directly against membrane, butt joints tightly, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions. Prime membrane prior to insulation/protection board installation as recommended by the system manufacturer. Ensure that the primer will not adversely affect the insulation/protection board.
- B. Place drainage panel over and directly against the insulation/protection board. Butt vertical joints and adhere a 12-inch wide filter fabric patch centered over the vertical joint. Butt horizontal joints and ensure that there is a minimum of 6-inches of filter fabric overlap from the upper panel over the lower panel. The top section of drainage panel is to have the drainage core removed for 6-inches to create a 6-inch wide flap of filter fabric that can be wrapped over the top of the panel and tucked and between the panel and the insulation/protection board. In lieu of cutting the drainage core, a 12-inch wide section of filter fabric can be adhered and wrapped similar to the vertical joints.
- C. Adhere insulation / protection board and drainage panel to substrate with compatible adhesive. Supplement the adhered system with self-stick insulation anchors as necessary to ensure that any part of the system will not pull loose from the wall.

3.05 PROTECTION

- A. Do not damage or permit traffic over unprotected or uncovered membrane.
- B. Backfill against drainage panel as soon as practical to prevent damage to the panel. Any damage to the system is to be repaired to new condition.

END OF SECTION 071400

SECTION 072100 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction and exterior wall behind gypsum board wall finish.
- B. Batt insulation in exterior wall construction.

1.02 RELATED REQUIREMENTS

- A. Section 042000 Unit Masonry: Supporting construction for insulation...
- B. Section 054100 Cold-Formed Exterior Steel Stud Framing: Supporting construction for sprayed-in-place and batt insulation.
- C. Section 071400 -Fluid-Applied Waterproofing: Rigid insulation/protection course over membrane waterproofing.
- D. Section 075200 Modified Bituminous Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.
- E. Section 078400 Firestopping: Fire safing.
- F. Section 092116 Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.
- G. Sections 23 in regards to duct, equipment and pipe insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- B. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials;
 2015a.
- D. ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
- E. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.04 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.06 SEQUENCING

A. Sequence work to ensure firestop materials are in place before beginning work of this section.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test

method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

- 1. Surface Burning Characteristics: ASTM E 84.
- 2. Fire Resistance Ratings: ASTM E 119.
- 3. Combustion Characteristics: ASTM E 136.

PART 2 PRODUCTS

2.01 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Flame Spread Index (FSI): Class A 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
 - 4. R-value; 1 inch of material at 72 degrees F: 5, minimum.
 - 5. Board Size at Cavity Wall: 16 x 96 inch.
 - 6. Board Thickness at cavity wall: 2 inches
 - 7. Board Edges: Square.
 - 8. Thermal Conductivity (k factor) at 25 degrees F: 0.18.
 - 9. Thermal Resistance: R of 7.5 for 1-1/2 inch.
 - 10. Compressive Resistance: 25 psi.
 - 11. Board Density: 1.6 lb/cu ft.
 - 12. Water Absorption, Maximum: 0.3 percent, by volume.
 - 13. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - a. Certainteed Saint Gobain: www.certainteed.com
 - b. Dow Chemical Company: www.dow.com.
 - c. Kingspan Insulation LLC: www.trustgreenguard.com/#sle.
 - d. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

2.02 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less; smoke developed index of 450 or less, when tested in accordance with ASTM E 84.
 - 2. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 3. Formaldehyde Content: Zero.
 - 4. Thermal Resistance: R-value of 21.
 - 5. Thickness: 5-1/2 inch.
 - 6. Facing: Unfaced.
 - 7. Recycled Content: Give preference to products having recycled content.
 - 8. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - a. Johns Manville: www.jm.com.
 - b. Knauf Insulation GmbH: www.knaufinsulation.us.
 - c. Owens Corning Corp: www.owenscorning.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Apply adhesive to back of boards:
 - 1. Three continuous beads per board length.
 - 2. Full bed 1/8 inch thick.
- B. Install boards horizontally on walls.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Extend boards over expansion joints, unbonded to wall on one side of joint.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- E. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.
- F. Tape insulation board joints.

3.03 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 072100

SECTION 075200 - MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Two-ply modified bituminous roofing membrane, conventional application.
- B. Hot roofing asphalt and/or cold adhesive (base and cap sheet).
- C. Insulation, flat and tapered.
- D. Base flashings.
- E. Roofing cant strips, accessories, and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 061000 Rough Carpentry: Wood nailers and curbs.
- B. Section 077100 Roof Specialties . Fascia.
- C. Section 077123 Manufactured Gutters and Downspouts.
- D. Section 077200 Roof Accessories: Roof-mounted units.
- E. Section 079005 Joint Sealers.
- F. Refer to Mechanical, electrical and plumbing sections for roof penetrations and roof drains.

1.03 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 for definitions of terms related to roofing work not otherwise defined in this Section.
- B. Hot Roofing Asphalt: Roofing asphalt heated to its equiviscous temperature, the temperature at which its viscosity is 125 centipoise for mop-applied roofing asphalt and 75 centipoise for mechanical spreader-applied roofing asphalt within a range of plus or minus 25 deg F (14 deg C) measured at the mop cart or mechanical spreader immediately before application.
- C. Thermal Resistivity (r-value) is the reciprocal of thermal conductivity (k-value) which is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (r-value) is expressed by the temperature difference in degrees F between two parallel surfaces required to cause 1 Btu to flow through 1 sq. ft. of a homogenous material exactly 1 inch thick per hour at the mean temperature indicated.
- D. Thermal Resistance (R-value) is the reciprocal of thermal conductance (C-value) which is the rate of heat flow through a material of the thickness indicated. Thermal resistance (R-value) is expressed by the temperature difference in degrees F between the two exposed faces required to cause 1 Btu to flow through 1 sq. ft. per hour at the mean temperature indicated.

1.04 REFERENCE STANDARDS

- A. ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures: Wind design.
- B. ASTM C728 Standard Specification for Perlite Thermal Insulation Board; 2013.
- C. ASTM C1289 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- D. ASTM D312/D312M Standard Specification for Asphalt Used in Roofing; 2015.
- E. ASTM D5147/D5147M Standard Test Method for Sampling and testing Modified Bituminous Sheet Material: 2014

- F. ASTM D6630 Standard Guide for Low Slope Insulated Roof Membrane Assembly; current edition.
- G. ASTM E108 Standard Test Methods for Fire Tests of Roof Coverings.
- H. UL (DIR) Online Certifications Directory; current listings at database.ul.com.
- I. UL (FRD) Fire Resistance Directory; current edition.
- J. UL 580 Tests for Uplift Resistance of Roof Assemblies; current edition.
- K. UL 1897 Uplift Tests for Roof Covering Systems; current edition.

1.05 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Install a watertight, modified bituminous membrane roofing and base flashing system with compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and exposure to weather without failure.
- B. ASCE 7-10: Provide cap sheet, base flashings, and component materials that meet the wind design requirements a as part of a roofing system, as applicable.
 - 1. Refer to the structural drawings for wind speeds, building exposure, and building risk category.
- C. UL Listing: Provide modified bituminous sheet roofing system and component materials that have been tested for application and slopes indicated and are listed by Underwriters Laboratories, Inc. (UL) for Class A external fire exposure.
 - 1. Provide roof-covering materials bearing UL Classification Marking on bundle, package, or container indicating that materials have been produced under UL's Classification and Follow-up Service.
 - 2. Provide modified bitumen sheet roofing system that has been tested in accordance with UL 580 or UL 1897.
- D. Insulation Fire-Performance Characteristics: Provide insulation materials that are identical to materials whose fire-performance characteristics have been determined for the assemblies of which the insulation materials are a part, per test method listed below, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Surface Burning Characteristics: ASTM E 84.
 - 2. Fire Resistance Ratings: ASTM E 119.
- E. All material, the installation thereof shall meet or exceed the minimum criteria of the Kentucky State Building Code.

1.06 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog data for membrane and bitumen materials, base flashing materials, insulation, vapor retarder, surfacing, and any other accessories.
- B. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.
- C. Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project from a model code organization to authorities having jurisdiction.
- D. Maintenance Data: For roofing system to include in the Operation and Maintenance Manuals specified in Division 1.

- E. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, mechanical fastener layout, and all accessories.
 - 1. Shop drawings to depict the coordination and integration of the wall systems. The Contractor will submit shop drawings showing the flashing, termination and system intersection conditions of all roofing and wall systems.
 - 2. Base flashings, cants and membrane terminations, at edges, parapets and high walls.
 - 3. Tapered insulation, including slopes.
 - 4. Crickets, saddles, and tapered edge strips, including slopes.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
 - 1. Submit written certification from manufacturer of modified bituminous sheet roofing system certifying that Installer is approved by manufacturer to install specified roofing system and required warranty will be provided. Refer to Form of Proposal for certification form to be turned in within 2 hours of the bid opening.
- H. Manufacturer's Installation Instructions: Indicate special procedures.
- I. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Signed by roofing system manufacturer certifying that the roofing system complies with requirements specified in the "Performance Requirements" Article. Upon request, submit evidence of complying with requirements.
- J. Manufacturer's Roof System Assembly Letter: Letter describing each roof assembly listing; deck type, insulation, fastening methods, and membrane.
- K. Manufacturer's Field Reports: Indicate procedures followed.
- L. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- M. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
 - 1. A copy of the unexecuted roofing warranty is to be submitted on bid day for review and approval by the Owner prior to award of contract.
- N. Inspection: Letter from the proposed primary roofing materials manufacturer confirming that the final inspection will be performed by a trained, technical representative. Sales personnel or agents will not be considered eligible to perform final inspection.
- O. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roof installation.
- P. Wind Uplift Design: Provide wind uplift calculation that include wind uplift performance tested per ASCE 7-10 Envelope Procedure. Calculations to include:
 - 1. Minimum Design Wind-Resistance Loads: Include field of roof, perimeter, and corner uplift pressures for each applicable roof area.
 - 2. Fastener pattern, spacing, and/or enhanced adhesive requirements.
 - 3. Additional wind uplift safety factors required by the building area, size or shape, and manufacturers requirements to meet the specified warranty requirements.
- Q. Manufacturer certificate, located at the end of this Section, to be submitted with the bid, for the proposed modified bituminous roof system confirming that the roof system installer is approved to install the proposed modified bituminus roof system.

1.07 SUBMITTAL OF EQUIVALENTS

- A. Substitutions: Division 0; Supplemental Instructions to Bidders; Substitution Request During Bidding Form.
- B. Submittals for primary roof systems to be considered as equivalents to the specified roof system shall be made no less than ten (10) days prior to bid date. Primary roof systems which have been reviewed and accepted as equivalents to the specified roof system will be listed in an addendum prior to bid date; only then will equivalents be accepted at bidding. Submittals of equivalents prior to bid shall include:
 - 1. Two (2) eight (8) inch by ten (10) inch samples of the primary roofing and flashing sheets.
 - 2. Latest edition of the roofing system manufacturer's specifications and installation instructions.
 - 3. Descriptive list of the materials proposed for use.
 - 4. Evidence of Underwriter's Laboratories Class A acceptance of the proposed roofing and flashing membrane system (including mopping asphalt or cold adhesive) without additional requirements for gravel or coatings. No other testing agency approvals for accepted.
 - 5. Evidence of ASCE 7-10 Testing for the proposed membrane system.
 - a. The roof configuration (including fastening of base sheet, insulation, etc.) shall be designed per wind uplift calculations.
 - Complete list of materials physical properties for each sheet including: low temperature flexibility bend; elongation at room temperature; and recovery properties; weights and thickness.
 - 7. Sample copy of the specified warranty, including a listing of items not covered by the warranty.

1.08 SUBMITTALS PRIOR TO PROJECT CLOSEOUT

- A. Certificate of Analysis from the testing laboratory of the primary roofing materials manufacturer, confirming the physical and mechanical properties of the roofing membrane components. Testing shall be in accordance with the parameters published in ASTM D5147 and UEAtc* and indicate Quality Assurance/Quality Control data as required to meet the specified properties. A separate Certificate and Analysis for each production run of material shall indicate the following information:
 - 1. Material type.
 - 2. Lot number.
 - 3. Production date.
 - 4. Dimensions and Mass (indicate the lowest values recorded during the production run);
 - a. length.
 - b. Width.
 - c. Selvage width.
 - d. Total thickness.
 - e. Thickness at selvage.
 - f. Weight.
 - 5. Physical and Mechanical Properties;
 - a. Low temperature flexibility.
 - b. Maximum load.
 - c. Elongation at 5% Maximum load.
 - d. Dimensional stability.
 - e. High temperature stability.
 - f. Granule embedment.
 - g. Resistance to thermal shock* (foil faced products).

1.09 QUALITY ASSURANCE

A. Manufacturer Qualifications:

- 1. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.
- 2. Obtain primary products, including each type of roofing sheet, bitumen, membrane flashings, and vapor retarder (if any), from a single manufacturer. Provide secondary products as recommended by manufacturer of primary products for use with roofing system specified.
- 3. Roof membrane manufacturer is to have an indemnity arrangement with the selected lightweight insulating concrete manufacturer to meet the special project full system roof warranty as specified.
- B. Installer Qualifications: Engage an experienced installer to perform Work of this Section who has specialized in installing roofing that is required for this Project; who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product; and who is eligible to receive the project specific full system roofing manufacturer's warranty as specified. A minimum of four (4) years experience with the manufacturer and the specified system is required.
 - 1. Installer's Field Supervision: Require Installer to maintain a full-time supervisor/foreman on job site during times that modified bituminous sheet roofing work is in progress and who is experienced in installation of roofing systems similar to type and scope required for this Project. A minimum of four (4) years experience with the manufacturer and the specified system is required.
- C. Fire-Test Response Characteristics: Provide roofing materials with fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - Fire-test Exposure: Class A; complying with ASTM E 108, for application and slopes indicated.

1.10 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.
- B. Review preparation and installation procedures and coordinating and scheduling required with related work.
- C. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at project site. Meet with Installer (Roofer), installers of substrate construction (roof decks) and other work adjoining roof system including penetrating work and roof accessories, Architect, Owner, and representatives of other entities directly concerned with performance of roofing system including (as applicable) Owner's insurers and test agencies. This meeting must be attended by the on site Foreman overseeing the work.
 - Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials, and installation facilities and establish preliminary installation schedule. Review requirements for inspections, testing, certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation procedures.
 - 2. Discuss roofing system protection requirements for construction period extending beyond roofing installation. Discuss possible need for temporary roofing.
 - Record discussion, including agreement or disagreement on matters of significance; furnish
 copy of recorded discussions to each participant. If substantial disagreements exist at
 conclusion of conference, determine how disagreements will be resolved and set date for
 reconvening conference.
- D. Preapplication Roofing Conference: Approximately 2 weeks before scheduled commencement of modified bitumen sheet roofing installation and associated work, meet at Project site with Installer, installer of each component of associated work, installers of roof drains, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Architect, Owner,

roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner's insurer s, test agencies, and governing authorities.

- 1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
- 2. Review foreseeable methods and procedures related to roofing work, including but not necessarily limited to the following:
 - a. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review structural loading limitations of steel deck and inspect deck for loss of flatness and for required mechanical fastening.
 - c. Review roofing system requirements (drawings, specifications, and other contract documents).
 - d. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - e. Review required submittals, both completed and yet to be completed.
 - f. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
 - g. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - h. Review required inspection, testing, certifying, and material usage accounting procedures.
 - Review temporary protection requirements for roofing system during and after installation.
 - j. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).
 - k. Review of roof observation and repair procedures after roofing installation.
- 3. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.11 COMPLETION MEETING

A. A meeting shall be held at the completion of the project and attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the Manufacturer's representative. The Contractor shall complete all punch list items and acquire Manufacturer's warranty for final submittal to Architect.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Store roofing materials in a dry, well-ventilated, weathertight location to ensure no significant moisture pickup and maintain at a temperature exceeding roofing system manufacturer's written

instructions. Store rolls of felt and other sheet materials on end on pallets or other raised surfaces. Do not double-stack rolls.

- 1. Handle and store roofing materials and place equipment in a manner to avoid significant or permanent damage to deck or structural supporting members.
- 2. Cover all materials using a breathable cover such as canvas. Polyethylene or other non-breathable plastic coverings are not acceptable.
- E. Do not leave unused felts and other sheet materials on the roof overnight or when roofing work is not in progress unless protected from weather and moisture and unless maintained at a temperature exceeding 50 deg F (10 deg C).
- F. Deliver and store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
- G. Any materials that are found to be damaged or stored in any manner other than stated above shall be automatically rejected and shall be removed and replaced at the Contractor's expense.
- H. Protect roofing insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

1.13 PROJECT CONDITIONS

- A. Coordinate the work with installation of associated flashings and counterflashings installed by other sections as the work of this section proceeds.
- B. Do not apply roofing membrane when environmental conditions are outside the ranges recommended by manufacturer.
- C. Do not apply roofing membrane during unsuitable weather.
- D. Do not apply roofing membrane when ambient temperature is below 40 degrees F.
- E. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- F. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- G. Temperature Restrictions Asphalt: At ambient temperatures of forty (40) degrees F and below, special precautions must be taken to ensure that the specified Type IV asphalt maintains a minimum acceptable 400 degrees F temperature at the point of sheet application. The asphalt must not be overheated to compensate for cold conditions. The use of insulated handling equipment is strongly recommended. Hot luggers, mop carts, and kettle-to-roof supply lines should be insulated. Hand mops should be constructed with a smaller yarn head to facilitate short moppings. Luggers and mop carts should never be more than half filled at all times.
- H. Temperature Restrictions Cold Adhesive: At low temperatures, the specified cold adhesive becomes more viscous, making even distribution more difficult. The cold adhesive should be stored in a warm place immediately prior to use. A shop squeegee should be used to assist in an even distribution of the adhesive (cut notches out of the rubber blade of the squeegee). Application should be suspended in situations where the adhesive cannot be kept at temperatures allowing for even distribution.
- I. Temporary Roofing: When adverse job or weather conditions prevent permanent roofing system from being installed according to requirements and Contractor determines that roofing cannot be delayed because of need for job progress or protection of other work, install temporary roofing. Engage roofing Installer to provide temporary roofing and to remove it prior to proceeding with permanent roofing work.

- J. Membrane Protection: Protection against staining and mechanical damages shall be provided for newly applied roofing and adjacent surfaces throughout this project.
- K. Site Condition: All job site clean-up including building exterior and landscaping, where affected by the construction, shall be completed to the Owner's satisfaction. All debris shall be removed daily from the project site and shall be taken to a legal dumping area authorized to receive such materials.

1.14 SEQUENCING AND SCHEDULING

- A. Sequence installation of modified bituminous sheet roofing with related units of Work specified in other Sections to ensure that roof assemblies, including roof accessories, flashing, trim, and joint sealers, are protected against damage from effects of weather, corrosion, and adjacent construction activity.
- B. Sequence removal of existing roofing materials and installation of new roofing system including temporary roofing, insulation and SBS roofing, to ensure roof is in a weathertight condition at the end of each day.
- C. Schedule work to ensure drainage of roof is maintained at all times.

1.15 WARRANTY

- A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Three executed copies of all warranties must be submitted to the Architect.
- B. Special Project Full System Warranty
 - 1. The entire installation from the metal deck up, including but not limited to insulation, fasteners, asphalt, roofing membranes, edge metals, copings, and base flashings, shall be warranted against defects in material and workmanship as evidenced by leaks, flashing membrane deterioration, blisters, splits, etc., as required to maintain roofing system in a watertight condition for the period stated below starting from the date of final acceptance by the Owner. Should leak occur, the Manufacturer shall repair or replace the roof materials as required, to provide a watertight condition, at its own expense, with no dollar limit or prorated amount. The warranty shall cover fully and completely the entire roofing system and the requirements as specified herein. Particularly warranty shall not include language releasing manufacturer of responsibility if not installed by approved roofing Contractor or in accordance with manufacturer's specifications, or FDR materials not specifically made by the manufacturer. It is the manufacturer's responsibility to know by whom and how roofing was installed to eliminate this. The guarantee is for a complete system and shall not be limited by any previous work accomplished on the roof prior to this contract and elected to remain as a part of the system herein specified:
 - a. Total Systems Warranty shall be for a period of twenty (20) years NDL from the date of substantial completion.
 - b. This warranty shall be jointly signed by the Manufacturer of the primary roofing material and the authorized installer.
 - c. Repairs and replacements required because of events beyond the Contractor's/Installer's/ Manufacturer's control and beyond the limits specified herein shall be completed by the Contractor/Installer and paid for by the Owner.
 - d. The Manufacturer shall provide interim inspection of the roof surface after two (2) years of service at no cost to the Owner to identify potential problems prior to damage and allow for a maintenance recommendation. Written reports of these inspections must be made and shared with the Owner and Architect.
- C. Division of Engineering and Contract Administration (DECA) Supplemental Provisions Rider (Governing Law)

- 1. This rider amends the warranty provided.
- 2. The Warranty is governed by and shall be construed and enforced in accordance with the internal laws of the Commonwealth of Kentucky, without giving effect to any choice of law rules that my require the application of laws of another jurisdiction.
- 3. In the event of a conflict between the provisions of the Warranty and the provisions of this rider, the provisions of this rider shall control.
- 4. Except as modified by this rider (and any other riders that are issued contemporaneously), the terms of the Warranty remain in full force and effect. Among other things, this rider does not extend the term of the Warranty, even if this rider is dated later than the date of the Warranty.
- D. Installer shall provide a typed certificate stating the following:
 - 1. Type of roof.
 - a. Installer.
 - b. Installer's address and telephone number.
 - Manufacturer.
 - d. Manufacturer's address and telephone number.
 - e. Who to contact in case of roof failure.
 - f. Warranty period with beginning and ending dates. Certificate shall be framed and bolted (not hung) on the wall as directed by Architect. Copies of certificate shall be included with manufacturer's written warranty and submitted to Architect.
 - g. Any representative who inspects roof must copy all inspection reports to the office of Ross-Tarrant Architects, Inc. for the life of the roof.
- E. Contractor's Warranty: Roofing contractor shall provide a written two (2) year warranty for materials and workmanship commencing with the date of substantial completion. The warranty shall cover all labor and all material necessary to maintain complete water tightness, including that required to repair and all roof leaks and water infiltration through the roof, flashings, and wall copings in any configuration including standing water at no additional cost to the Owner.
- F. Warranty Work: All warranty and/or maintenance work shall be documented by the individual performing the work with before and after pictures of the work and a detailed breakdown of cost. Submit to the Owner and the Architect. Time spent by the Architect for manufacturer warranty problems shall be billed to the manufacturer
- G. Recommended Maintenance: In addition to the guarantee, the Contractor shall furnish to the Owner the Manufacturer's printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration addition policies, temporary repairs, and leak call procedures.
 - 1. Arrange for a meeting of the Owner, Architect, Manufacturer, and Installer to review procedure for general maintenance by the Owner that will not void warranty, as well as procedure for reporting roof problems, maintenance, and/or warranty problems to manufacturer.
 - 2. All warranty and/or maintenance work shall be documented by the individual performing the work with before and after pictures of the work and detailed breakdown of cost. Submit to Owner and Architect time spent by Architect for manufacturer's warranty problems shall be billed to the manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Membrane Materials:
 - 1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. LaFargeHolcim/Firestone Building Products Company: www.firestonebpco.com.
 - b. GAF/ Siplast: www.siplast.com.
 - c. Johns Manville. www.jm.com

- d. Soprema: www.soprema.us
- e. Substitutions: Refer to submittal of equivalents information listed in previous paragraphs.
- B. Roofing Membrane Assembly: The roof membrane assembly shall consist of two (2) plies of a prefabricated, fiberglass or polyester reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, secured to a prepared substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. The modified bitumen first ply shall be adhered in cold adhesive or hot mopped to the modified bitumen base ply. The modified bitumen second ply/cap sheet can be adhered in cold adhesive or hot mopped. Each sheet of the roof assembly shall meet the following physical requirements as a minimum, but no less than as required for providing stated warranty.
 - 1. Basis of Design: Johns Manville 2FID

2.02 SHEET ROOFING MATERIALS

- A. Base Sheet: Base sheet shall meet or exceed the requirements of ASTM D-4601 Type II nonperforated, asphalt-impregnated and coated, fiberglass base sheets. Minimum weight: 20 lb/100 sq. ft.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. JM PermaPly 28
 - b. Siplast Parabase
 - c. Firestone MB Base M
- B. Roofing Membrane Base Sheet: ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. JM DynaBase
 - b. Siplast Paradiene 20
 - c. Firestone SBS Base
 - d. Soprema Elastophene Sanded 2.2"
 - 2. Properties:
 - a. Roof Covering Classification: Class A.
 - b. Thickness (avg.) 90 mils-2.3 mm (ASTM D 5147).
 - c. Thickness (min.) 87 mils-2.2 mm (ASTM D 5147).
 - d. Weight (min. per 100 ft² of coverage) 62 lb.-3.0 kg/m².
 - e. Filler content in elastomeric blend-less than 35% by weight.
 - f. Low temperature flexibility at -13 degrees Fahrenheit (-25 degrees Celsius) PASS (ASTM D 5147).
 - g. Maximum load (avg.) at 73 degrees Fahrenheit 30 lbf/inch (ASTM D 5147).
 - h. Maximum load (avg.) at 0 degrees Fahrenheit 70 lbf/inch (ASTM D 5147).
 - i. Elongation at 5% Maximum Load (avg.) at 73 degrees Fahrenheit 50% (ASTM D 5147).
 - j. Dimensional Stability (max.) 0.5% (ASTM D 5147).
 - k. High Temperature Stability (min.) 250 degrees Fahrenheit (121° C).
 - 1. Approvals UL Class listed, FM Approved (products shall bear seals of approval)
 - m. Reinforcement fiberglass mat or other meeting the performance criteria.
- C. Roofing Membrane Cap Sheet: ASTM D 6163, Grade G, Type I or II, glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. JM DynaGlas FR

- b. Siplast Paradiene 30 FR
- c. Firestone SBS Glass FR
- d. Soprema Elastophene FRGR
- 2. Properties:
 - a. Roof Covering Classification: Class A.
 - b. Thickness (avg.): 130 mils 3.3 mm.
 - c. Thickness at selvage (avg.): 98 mils 2.5 mm (ASTM D 5147).
 - d. Thickness at selvage (min.): 94 mils 2.4 mm (ASTM D 5147).
 - e. Weight (min. per 100 ft² of coverage) 90 lb. 4.4 kg/m².
 - f. Filler content in elastomeric blend less than 35% by weight.
 - g. Low temperature flexibility at -13 degrees Fahrenheit (-25 degrees Celsius) PASS (ASTM D 5147).
 - h. Maximum Load (avg.) at 73 degrees Fahrenheit 30 lbf/inch (ASTM D 5147).
 - i. Maximum Load (avg.) at 0 degrees Fahrenheit 70 lbf/inch (ASTM D 5147).
 - j. Elongation at 5% Maximum Load (avg.) at 73 degrees Fahrenheit 55% (ASTM D 5147).
 - k. Dimensional Stability (max.) 0.5% (ASTM D 5147).
 - 1. High Temperature Stability (min.) 250 degrees Fahrenheit (121° C) (ASTM D 5147).
 - m. Granule Embedment (max. loss) 2.0 grams per sample (ASTM D 5147).
 - n. Approvals UL Class listed, FM Approved (products shall bear seals of approval).
 - o. Reinforcement fiberglass mat or other meeting the performance criteria.
 - p. Surfacing ceramic granules; white.
- D. Roofing Membrane Flashing Sheet: ASTM D 6298, glass-fiber-reinforced, SBS-modified asphalt sheet; metal-foil surfaced; suitable for application method specified, and as follows:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. JM DynaClad
 - b. Siplast Veral Aluminum
 - c. Firestone Metal Flash-Al
 - d. Soprema Sopraplast 50 TV Alu Sanded
 - 2. Properties:
 - a. Thickness (avg.) 142 mils 3.6 mm (ASTM D 5147).
 - b. Thickness (min.) 138 mils 3.5 mm (ASTM D 5147).
 - c. Weight (min. per 100 ft² of coverage) 92 lb. 4.5 kg/m².
 - d. Filler content in elastomeric blend less than 35% by weight.
 - e. Low temperature flexibility at 0 degrees Fahrenheit (-18 degrees Celsius) PASS (ASTM D 5147).
 - f. Maximum Load (avg.) at 73 degrees Fahrenheit 85 lbf/inch (ASTM D 5147).
 - g. Maximum Load (avg.) at 0 degrees Fahrenheit 180 lbf/inch (ASTM D 5147).
 - h. Elongation at 5% Maximum Load (avg.) at 73 degrees Fahrenheit 45% (ASTM D 5147).
 - i. Dimensional Stability (max.) 0.5% (ASTM D 5147) (ASTM D 5147).
 - j. High Temperature Stability (min.) 225 degrees Fahrenheit (107° C) (ASTM D 5147).
 - k. Thermal Shock Resistance (maximum) 0.2% (UEAtc standard).
 - 1. Approvals UL Approved, FM Approved (products shall bear seals of approval).
 - m. Reinforcement fiberglass scrim mat or other meeting the performance criteria.
 - n. Surfacing aluminum metal foil.
 - o. Reinforcing Ply: Same as roof system base ply.
 - p. Base Sheet: ASTM D 4601, Type II non-perforated, asphalt-impregnated and -coated, glass-fiber sheet, with a polyolefin film backing. Minimum weight: 20 lb/100 sq. ft.

2.03 ROOFING ACCESSORIES

- A. Roofing Adhesives: Contractor option:
 - 1. Mopping Asphalt: Certify asphalt for full compliance with the requirements for Type IV asphalt listed in Table I, ASTM D 312-15. Each container or bulk shipping ticket shall indicate the equiviscous temperature, EVT, the finished blowing temperature, FBT, and the flash point, FP.
 - a. Base sheet and cap sheet installation.
 - b. Acceptable Products: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1) Siplast: www.siplast.com.
 - 2) Owens Corning Roofing & Asphalt, LLC: Trumbull Built-up Roofing Asphalt Low VOC: www.owenscorning.com
 - 2. Cold Application Adhesive: Two component, elastomeric, cold application adhesive, consisting of an asphalt base material. Product to meet ASTM 3019 Type III, Grade 2. Provide products acceptable to roof system manufacturer.
 - a. Base sheet and cap sheet installation.
 - b. Acceptable Products: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1) Firestone Building Products Co: www.firestonebpco.com.
 - 2) Siplast: www.siplast.com.
 - 3) Johns Manville: www.jm.com
- B. Bituminous Cutback Materials
 - 1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D 41-85 requirements.
 - Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D 4586-86 Type II and FED SPEC NO.SS-C-153, TYPE I requirements.
- C. Base Sheet Fasteners: Roof manufacturers ASCE 7-10 approved system fasteners to meet wind uplift pressures. A one-piece specially coated galvanized steel fastener with a spilt wedge leg designed for use into lightweight insulating concrete to provide a minimum of 40 lbs pullout resistance.
 - 1. Acceptable base sheet fasteners manufacturers:
 - a. ES Product Inc.
 - b. Simplex Nail and Manufacturing Company Tube-Lok Nail
 - c. NTB Inc. NTB Fastener
 - d. Firestone LWC Base Ply Fastener
- D. Caulking/Sealants. A single component, high performance, elastomeric sealant. Acceptable types are as follows: ASTM C920, FED SPEC NO.TTS 0023C TYPE II C
 - 1. Black Jack No. 1010 by Gibson-Homans; Twinsburg, OH (216) 425-3255.
 - 2. Approved Equivalents.
- E. Ceramic Granules. No.11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.
- F. Metallic Powder. A finely graded metal dust as supplied or approved by the membrane manufacturer, used for covering of bitumen overruns over the foil surfaced membrane.
- G. Tapered Perlite Edge Strip: Provide perlite on top of blocking at parapets with fascia. Material to have 2 hour water absorption of 1.5 max and to comply with ASTM C 209, C 165, and C 203.
 - 1. Basis of Design: Johns Manville Tapered Fesco Edge Strip.
- H. Tapered and Flat Polyisocyanurate Board at Roof Drain Sumps: Provide tapered and flat polyisocyanurate insulation in the roof drain sump. Tapered and flat panels composed of closed cell

polyisocyanurate, which are bound with fiber glass reinforced facers on both sides. Provide panels that are in full compliance with ASTM C 1289, Type II, Class 1, Grade 2, 20 psi. The tapered panels shall provide for a slope of one quarter (1/4) inch per foot.

- Cant Strip Asphalt impregnated wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- J. Pipe Flashing: Soft metal pipe flashing approved per manufacturer:
 - 1. Sheet lead, minimum 2-1/2 lb/per sq. ft. or soft sheet copper, minimum 16 oz.
- K. Roof Drain Flashing: Soft metal flashing approved per manufacturer:
 - 1. Sheet lead, minimum 2-1/2 lb/per sq. ft. or 16 oz. soft sheet copper.
- L. Walkway Pads: Provide walkway pads in locations as shown on the drawings. Provide modified bitumen sheet material with an asphalt impregnated, puncture resistant polyester fabric core, coated with a polymer modified bitumen and topped with a ceramic-coated granule wearing surface. Color of walkway pads to contrast with selected roof color. Minimum walkway pad size to be 32" x 32". If roll products are used then the max length of each pad is to be 32" x 4'-0" in length. Provide space between each pad to allow for water drainage. The pad should be set in hot asphalt. All four corners are to be adhered.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. JM DynaTred
 - b. Siplast ParaTread
 - c. Firestone SBS Cap
 - d. Soprema Soprawalk
- M. Sealants: As recommended by membrane manufacturer.

2.04 THERMAL INSULATION

- A. General: Rigid roof insulation used for this project shall be UL and FM approved. Each type of insulation used shall be approved in writing by the insulation manufacturer for intended use, and for use with the specified roof assembly.
- B. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 2, and with the following characteristics:
 - 1. Compressive Strength: 20 psi
 - 2. Board Size: 48" x 48" inch. Maximum panel size listed shall be maintained where insulation is installed in hot asphalt.
 - 3. Board Thickness: 2 inch.
 - 4. Layers: Provide two layers.
 - 5. Thermal Resistance: Aged R-value of minimum 5.7 per inch. ASTM C518 aged "R" value at 75 degrees F (or RIC/TIMA Conditioning Procedure 281-1).
 - 6. Board Edges: Square.
 - 7. Joints: Joints in second layer shall not coincide with joints of the first layer. The course shall be staggered to ensure this.
 - 8. UL: Class A.
 - 9. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - a. Atlas Roofing Corporation: www.atlasroofing.com.
 - b. Dow Chemical Company: www.dow.com.
 - c. Carlisle SynTec: www.carlislesyntec.com
 - d. Hunter Panel: www.hpanels.com
 - e. Johns Manville: www.jm.com.
 - f. Firestone Building Products Company: www.firestonebpco.com
 - g. R-Max.: www.rmaxinc.com

- h. Siplast: www.siplast.com
- i. Soprema: www.soprema.com
- j. Other manufacturers approved by roofing manufacturer to meet full system warranty requirements.
- C. Tapered Insulation Board: Roof insulation system of tapered panels composed of closed cell polyisocyanurate, which are bound with fiber glass reinforced facers on both sides. Provide panels that are in full compliance with ASTM C 1289, Type II, Class 1, Grade 2, 20 psi. The panels shall provide for a roof slope of one quarter (1/4) inch per foot.
 - 1. Panels installed in hot asphalt shall have maximum panel size of four (4) feet by four (4) feet
 - 2. At contractor's option, provide tapered perlite panels meeting ASTM C728.
- D. Tapered Pre-Cut Crickets: Roof insulation system of tapered panels composed of a foam core which are bound with fiber glass reinforced facers on both sides. Provide panels that are in full compliance with ASTM C 1289, Type II, Class 1, Grade 2, 20 psi. The panels shall provide for a roof slope of one quarter (1/4) inch per foot.
 - 1. At contractor's option, provide tapered and standard perlite panels meeting ASTM C728.

2.05 INSULATION OVERLAY BOARD

- A. Insulation Overlay Board: Overlay board as required by the roofing membrane manufacturer to meet specified warranty requirements. Contractor to coordinate roof blocking thickness with overlay board selected. Contractor option to provide perlite, perlite based, wood fiber, or glass mat gypsum roof board as the insulation overlay board as follows. Deletion of the cover board is not allowed, even if manufacturers warranty requirements do not require a cover board.
 - 1. Perlite Overlay Board: Expanded perlite mineral aggregate, ASTM C728, Type 1, with the following characteristics:
 - a. Board Size: 48 x 48 inch.
 - b. Board Thickness: 1 inch.
 - c. Board Edges: Square.
 - d. Manufacturers:
 - Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - (a) JM Fesco Board: www.jm.com
 - (b) Additional Manufacturers: Provide perlite overlay board as approved by the roof manufacturer to meet the total system roof warranty requirements.
 - 2. Perlite Based Overlay Board: Coated, expanded perlite and reinforcing cellulosic fibers, ASTM C728, Type 2, with the following characteristics:
 - a. Board Size: 48 x 48 inch.
 - b. Board Thickness: 1/2 inch.
 - c. Board Edges: Square.
 - d. Manufacturers:
 - Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - (a) JM Retro-Fit Board: www.jm.com
 - (b) Additional Manufacturers: Provide perlite based overlay board as approved by the roof manufacturer to meet the total system roof warranty requirements.
 - 3. Wood Fiber Overlay Board: High-density wood fiber board, ASTM C 208, Type II, grade 2, with the following characteristics:
 - a. Board Size: 48 x 48 inch.
 - b. Board Thickness: 1/2 inch
 - c. Board Edges: Square.

- d. Manufacturers:
 - Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - (a) Siplast Wood Fiberboard: www.siplast.com
 - (b) Firestone Fibertop: www.firestonebpco.com
 - (c) Blueridge Fiberboard Structodek High Density: www.blueridgefiberboard.com
 - (d) Additional Manufacturers: Provide wood fiber overlay board as approved by the roof manufacturer to meet the total system roof warranty requirements.
- 4. Glass Mat Gypsum Roof Overlay Board: Fiberglass faced non-combustible gypsum core board manufactured to meet ASTM C1177. Flame Spread 0 and Smoke Developed 0 per ASTM E84. Meets UL 790 for Class A roof assemblies.
 - a. Acceptable Products: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include::
 - 1) Georgia Pacific DensDeck Prime Roof Board
 - 2) USG Securock Gypsum-Fiber Roof Board
 - Additional Manufacturers: Provide glass mat gypsum overlay board as approved by the roof manufacturer to meet the total system roof warranty requirements.

2.06 INSULATION AND COVER BOARD ATTACHMENT

- A. General: Provide insulation fasteners and plates that are FM approved and/or approved by the manufacturer of the primary roofing products. The insulation fasteners shall provide attachment required to meet the specified uplift performance and to restrain the insulation panels against the potential for digging, etc. The fastening pattern for each insulation panel to be used shall be as recommended by the insulation manufacturer and approved by the manufacturer of the primary roofing products.
- B. Metal Decks: Base layer of insulation installed with mechanical fasteners and metal plates for metal decks that have been factory coated for corrosion resistance, and when subjected to 30 Kesternich cycles, must show less than 100% red rust, conforming to Factory Mutual 4470. Acceptable insulation fasteners types for metal decks are listed below:
 - 1. A single unit, precision formed, fluorocarbon coated screws type roofing fastener having a minimum of one hundred seventy-two thousandths (.172) inch diameter shank and a minimum two hundred-twenty-thousandths (.220) inch diameter thread. All plates used with fastener shall be a metal type having a minimum three (3) inch diameter as supplied by the fastener manufacturer.
 - a. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - 1) ITW Buildex Roofgrip with Buildex Metal Plates.
 - 2) Construction Fasteners, Inc. Dekfast #12 with Dekfast Hexagonal Plates.
 - 3) Olympic Fasteners #12 Standard Roofing fastener.
- C. Concrete Deck: Provide insulation adhesive:
 - 1. Provide a FM approved and/or approved by the manufacturer of the primary roofing products low-rise foam adhesive. Bead/ribbon spacing to meet FM, wind speed and warranty requirements as specified elsewhere in this section
 - 2. Install the first course of insulation.
- Insulation Adhesive: Second layer of insulation and cover board installed over polyisocyanurate insulation
 - 1. Provide a FM approved and/or approved by the manufacturer of the primary roofing products insulation adhesive or low-rise foam adhesive. Low-rise bead/ribbon spacing to meet FM, wind speed and warranty requirements as specified elsewhere in this section

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Cooperate with inspection and test agencies engaged or required to perform services in connection with installing modified bitumen sheet roofing system.
- B. Protect other work from spillage of modified bitumen roofing materials, and prevent liquid materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of modified bituminous sheet roofing system work.
- C. Insurance/Code Compliance: Where required, install and test modified bitumen sheet roofing system to comply with governing regulations and specified insurance requirements.
- D. Coordinate installing roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight and allow precipitation to flow freely from the roof. Provide cut offs at end of each day's work to cover exposed ply sheets and insulation with a course of coated felt with joints and edges sealed with roofing cement. Avoid phasing of installation creating and "insulation jam" with the potential of ponding water on the roof, at the close of the work day. Remove cut offs immediatly before resuming work.
- E. Cutoffs: At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and any insulation. Provide temporary covering of two plies of No. 15 roofing felt set in full moppings of hot bitumen; remove at beginning of next day's work.

3.02 EXAMINATION

- A. Examine substrate surfaces to receive modified bitumen sheet roofing system and associated work and conditions under which roofing will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- B. Verify that surfaces and site conditions are ready to receive work.
- C. Verify deck is supported and secure.
- D. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system. Verify that the flatness of the lightweight insulating concrete deck comply with installation tolerances specified in Division 3 section "Lightweight Insulating Concrete".
- E. Verify deck surfaces are dry and free of snow or ice.
- F. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips, nailing strips, and reglets are in place.
- G. Verify that nailers and blocking match thickness of the roof insulation.
- H. Verify that roof drains are securely clamped in place.

3.03 PREPARATION

- A. Tear off existing roof membrane, insulation and flashings down to the structural deck.
- B. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to the roofing system manufacturer's written instructions. Remove sharp projections.
- C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof drain plugs when no work is taking place or when rain is forecast.

3.04 CONCRETE DECK PREPARATION

- A. Fill surface honeycomb and variations with latex filler.
- B. Contractor to confirm dry deck by moisture meter with 12 percent moisture maximum.
- C. Test concrete substrate for excessive moisture by pouring one pint of hot bitumen 2400 degrees F on EVT on deck at start of each days work and at start of each roof area or plane. Do not proceed with roofing work if test sample forms can be easily stripped after cooling then substrate is too wet.

3.05 METAL DECK PREPARATION

- A. Install deck sheathing on metal deck:
 - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.

3.06 INSULATION INSTALLATION

- A. Attachment of Insulation:
 - 1. Roof Type #1: Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and ASCE requirements.
 - Roof Type #1A: Fully adhere first layer of insulation to deck in insulation adhesive or lw-rise foam adhesive.
 - 3. Roof Type #1 & 1A: Embed second layer of insulation into flood coat mopping of hot bitumen in accordance with roofing and insulation manufacturers' instructions.
 - Contractor option to install second layer in insulation adhesive or low-rise foam adhesive.
 - 4. Embed cover board into flood coat mopping of hot bitumen in accordance with roofing and board manufacturers' instructions.
 - Contractor option to install cover board in insulation adhesive or low-rise foam adhesive.

B. Roof Insulation:

- 1. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.
- 2. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions
- On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- 4. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- 5. Do not apply more insulation than can be covered with membrane in same day.

C. Roof Drain Sump Insulation:

At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.

D. Roof Insulation - Metal Deck

- 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions .
- Adhere subsequent layers of insulation with joints staggered minimum 6 inch from joints of
 preceding layer in accordance with roofing manufacturer's instructions and Factory Mutual
 requirements.
- 3. Adhere cover board with joints staggered minimum 6 inch from joints of preceding layer in accordance with roofing manufacturer's instructions and Factory Mutual requirements.

- 4. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- 5. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- 6. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- 8. Do not apply more insulation than can be covered with membrane in same day.

E. Roof Insulation - Structural Concrete

- 1. Hot mop or fully adhere first layer of insulation to deck in accordance with roofing manufacturer's instructions .
- 2. Adhere subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
- 3. Adhere cover board with joints staggered minimum 6 inch from joints of preceding layer in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
- 4. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- 5. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- 6. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- 7. Do not apply more insulation than can be covered with membrane in same day.

3.07 MEMBRANE APPLICATION

- A. Apply membrane in accordance with manufacturer's instructions.
- B. Apply membrane; lap and seal edges and ends permanently waterproof.
- C. Apply smooth, free from air pockets, wrinkles, fish-mouths, or tears. Ensure full bond of membrane to substrate.
- D. At end of day's operation, install waterproof cut-off. Remove cut-off before resuming roofing.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 8 inches onto vertical surfaces.
 - 2. Apply flexible flashing over membrane.
- F. Around roof penetrations, mop in and seal flanges and flashings with flexible flashing.
- G. Coordinate installation of roof drains and sumps and related flashings.
- H. Asphalt Bitumen Heating: Heat and apply bitumen according to EVT Method as recommended by NRCA. Do not raise temperature above minimum normal fluid-holding temperature necessary to attain EVT (plus 5 deg F or 14 deg C, at point of application) more than 1 hour prior to time of application. Determine flash point, finished blowing temperature, EVT, and fire-safe handling temperature of bitumen either by information from manufacturer or by suitable tests. Do not exceed recommended temperature limits during bitumen heating. Do not heat bitumen to a temperature higher than 25 deg F (14 deg C) below flash point. Discard bitumen that has been held at temperature exceeding finished blowing temperature (FBT) for more than 3 hours. Keep kettle lid closed except when adding bitumen. Comply with manufacturer's recommendations where more stringent.
- I. Bitumen Mopping Weights: For interply mopping, apply bitumen at the rate of 25 lb of asphalt per roof square (plus or minus 25 percent on a total-job average basis).

J. Substrate Joint Penetrations: Do not allow bitumen to penetrate substrate joints and enter building or damage insulation, vapor barriers (retarders), or other construction. Where mopping is applied directly to a substrate, tape joints or, in the case of steep asphalt, hold mopping back 2 inches from both sides of each joint.

3.08 ROOF MEMBRANE INSTALLATION

- A. General: Application of roofing shall be in accordance with roofing system manufacturer's instructions and the following requirements. Each SBS sheet shall be manufactured as an independent waterproofing layer, allowing for phased construction between layers.
- B. Aesthetic Considerations The overall appearance of the finished roof application is a standard requirement for this project. The contractor shall make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic powder, etc.), and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Shingling Plies: Shingle in proper direction to shed water on each large area of roofing.
- D. Cant Strips/Tapered edge Strips: Install preformed 45-degree cant strips at junctures of modified bituminous sheet roofing system membrane with vertical surface. Provide preformed, tapered edge strips at perimeter edges of roofs that do not terminate at vertical surfaces.
- E. Priming. Prime metal flanges (all jacks, edge metal, lead drain flashings, etc.) and concrete and masonry surfaces with a uniform coating of asphalt primer ASTM D 41-85.
- F. Kettles and Tankers. Kettles and tankers shall be equipped with accurate, fully readable thermometers. Asphalt shall not be heated to or above its flash point. Avoid heating at or above the FBT, should conditions make this impractical, heating must be no more than 25 degrees below the EVT and no more than 25 degrees F above EVT.
- G. Asphalt Temperatures. If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F. Thermometers shall be on the job at all times; one at the kettle and one on the roof at the mop.
- H. Asphalt Moppings. Ensure that all moppings do not exceed a maximum of 25 pounds/square. Mopping shall be total in coverage, leaving no breaks or voids.
- I. Bitumen Consistency. Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- J. Roofing Application. Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams in the base ply layer should not coincide with the lap seams of the finish ply layer. The courses should be staggered to ensure this.
 - 1. Apply all layers of roofing perpendicular to the slope of the deck.
 - 2. Base Sheet: Fully bond the base ply to the prepared substrate, having a minimum of three (3) inch side and end laps. Each sheet shall be applied directly behind the asphalt applicator. Stagger end labs a minimum of three (3) feet.
 - 3. Top Sheet: Fully bond the finish ply to the base ply, having a minimum of three (3) inch side and end laps. Each sheet shall be applied directly behind the asphalt or cold adhesive applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of twelve (12) inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
 - a. Extend modified bituminous sheet to top edge of cant strip and terminate.
 - b. Nail edges of membrane to wood blocking at perimeter edges of roof prior to installing metal gravel stops/fascias. Space nails at minimum 3 inches o.c.

- 4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds one-half (½) inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
- K. Granule Embedment. Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic surface color.
- L. Set on Accessories: Comply with manufacturers recommendations as required for specified warranty.

3.09 MEMBRANE FLASHING AND STRIPPING

- A. General: Install modified bituminous flashing at cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof in accordance with manufacturers printed specifications and details.
- B. Flashing Application Masonry. Flashing shall be accomplished using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch laps, extending a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. Adhere the reinforcing sheet by mopping/torching; ensuring full adhesion. Never coincide with the laps of the metal foil flashing layer with the lap seams in the reinforcing layer. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer to foil surfaces; allowing primer to dry thoroughly. Torch apply the metal foil flashing into place using three foot lengths (cut from the end of roll) and using the factory selvage edge for laps, extending a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers.
 - 1. Contractor option to install flashing as described above utilizing flashing cement and heat welding the seams.
- C. Use of Metallic Powder. Broadcast metallic powder over all bitumen overruns on the metal foil membrane surface while the bitumen is still hot to ensure a monolithic surface color.
- D. Water Cut-Off. At end of day's work, or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to the resumption of roofing.
- E. Allow for expansion of running metal flashing and edge trim that adjoins roofing. Do not seal or bond membrane or modified bituminous flashing or stripping to metal flanges over 3 feet in length.

3.10 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. General: Incorporate flanged components not the system between the application of the base ply and the finish ply. The flange must be primed with a uniform coating of approved ASTM D41-85 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.
- B. Counter-Flashings: Counter-flashings, cap flashings, expansion joints, and similar work to be coordinated with modified bitumen roofing work are specified in other Sections.
- C. Edge Metal. Completely prime metal flanges and allow to dry prior to installation. Turn the base ply down two (2) inches past the roof edge and over the nailer. After the base ply and continuous cleat (if applicable) have been installed, set the flange in mastic and stagger nail every three (3) inches on center. Strip-in the flange using the base ply material, extending a minimum of four (4) inches beyond the edge of the flange. The finish ply shall then be applied, terminating at the gravel-stop rise of the edge metal.

- D. Lead Pipe Flashings. Completely prime the lead flanges and allow to dry prior to installation. After the base ply has been applied, set the flange in mastic and strip-in the flange using the base ply material, extending a minimum of four (4) inches beyond the edge of the flange. The finish ply shall then be applied, terminating at the flange-sleeve juncture of the pipe flashing.
- E. Lead Roof Drain Flashings. Completely prime the lead drain flashing and allow to dry prior to installation. After the base ply has been applied, set the lead flashing sheet in mastic and form to turn down inside of the drain bowl. Ply-in the perimeter of the lead flashing using and additional layer of the base ply material, overlapping the perimeter of the lead a minimum of four (4) inches. The finish ply shall then be applied, extending beyond the clamping ring seal. Install the clamping ring with all clamps, bolts, etc., in place.
- F. Metal Pipe Flashings. Completely prime the metal pipe flanges and allow to dry prior to installation. After the base ply has been applied, set the flanges in mastic and strip-in the flange using the base ply material, extending a minimum of four (4) inches beyond the edge of the flange. The finish ply shall then be applied, terminating at the flange-sleeve juncture of the pipe flashing.
 - 1. These components are used to flash heat pipes, equipment supports (round pylons) and pipe penetrations where movement is anticipated.
- G. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.

3.11 FIELD QUALITY CONTROL

- Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner seven days in advance of date and time of inspection.
- C. Final Roof Inspection Report: After final roof inspection is completed one copy of the final report (hardcopy or digital format) shall be provided to the General Contractor/Construction Manager, Architect, and Roofing Installer.
- D. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 CLEANING

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

3.13 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.
- C. Protect roofing during remainder of construction period. At end of construction period, or at a time when remaining construction will in no way affect or endanger roofing, inspect roofing and prepare a

- written report, with copies to Architect and Owner, describing nature and extent of deterioration or damage found.
- D. Repair or replace (as required) deteriorated or defective work found at time of above inspection to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- E. All areas around job site shall be free of debris, roofing materials, equipment and related items after completion of job.
- F. Drain verification. At final inspection of all work, Contractor shall verify that all drains, scuppers, etc., are functioning properly. Drains shall have adequate strainers.

3.14 POST INSTALLATION MEETING

A. A meeting shall be held at the completion of the project and attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the Manufacturer's representative. The Contractor shall complete all punch list items and acquire Manufacturer's warranty for final submittal to Architect.

END OF SECTION 075200

SECTION 075200.01 - MODIFIED BITUMINOUS ROOFING SYSTEM MANUFACTURER'S **CERTIFICATION**

MODIFIED BITUMINOUS ROOFING SYSTEM MANUFACTURER'S CERTIFICATION

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

| | mpleted and submitted within 24 hours after bids are received. Fa ification may be cause for rejection of the bidder's proposal. |
|--|---|
| Date Submitted: | |
| Name & Address of Roofing | Systems Manufacturer: |
| | |
| Name & Address of Roofing | Systems Installer: |
| | |
| I certify thatapplicator of our roofing system conditions for the manufacture manufacturer's guarantee for | (Name of Roofing Installer) is an approved ems, and upon completion of this project, providing all terms and rer's guarantee are met, we will provide a no-dollar-limit 20-year the roof. |
| Signed: | Title: |

(Roofing Systems Manufacturer)

A.

SECTION 077100 - MANUFACTURED ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including: drip edge, fascia, and rake edge

1.02 RELATED REQUIREMENTS

- A. Section 075200 Modified Bituminous Membrane Roofing.
- B. Section 077123 Manufactured Gutters and Downspouts: Gutter and downspout
- C. Section 077200 Roof Accessories: Manufactured curbs, roof hatches.
- D. Section 079005 Joint Sealers.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM D4586/D4586M Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- C. NRCA (RM) The NRCA Roofing Manual; 2017.
- D. SMACNA (ASMM) Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- C. Selection Samples: For each item with a paint finish specified, submit color chips representing manufacturer's full range of available colors. Submit actual samples not photo reproductions.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) details.

1.06 WARRANTY

- A. Refer to roofing membrane section 075200 for Special Project Full System Warranty requirements for items to be included from this specification section.
- B. Finish Warranty: Manufacturer's 20-year finish warranty stating products to be free of corrosion, checking, crazing, chalking, discoloring, fading, oxidation, and that exposed finish surface will not peel, crack, chip, or spall.
 - 1. Excessive color change/fading greater than 5 NBS (Hunter) units and passing 5000 hrs per ASTM D 2249-85, ASTM D 2244 and ASTM D 822-85 respectively.
 - 2. Chalking shall not be less than a rating of No. 8 per ASTM D 659 and ASTM D 4214.
 - 3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Fascia

- 1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, and aesthetics of the following:
 - Metal-Era; Anchor-Tite: www.metalera.com
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Architectural Products Co.: www.archprod.com.
 - 2) Dimensional Metal Inc. (DMI): www.dmimetals.com
 - 3) Firestone Building Products, Inc.: www.firestonebpco.com
 - 4) OMG Roofing Products/OMG Edge Systems formerly W. P. Hickman: www.omgroofing.com
 - 5) Metal-Era Inc: www.metalera.com.
 - 6) Johns Manville: www.jm.com
 - 7) Metal Roofing Systems: www.metalroofingsystems.biz
 - 8) MM Systems Corp: www.mmsystemscorp.com
 - 9) Sika Saranfil: www.sarnafilus.com
 - 10) Siplast: www.siplast.com
 - 11) Soprema: www.soprema.us
- 2. Provide fascia in shapes and sizes indicated, with shop-mitered and welded-corners. Include water dams formed from at least 0.028-inch- (0.7-mm-) thick, galvanized steel sheet; anchor plates; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.
- 3. High performance roof edge system shall be certified by the manufacturer to comply with ANSI/SPRI Standard ES-1-98. Roof edge shall meet performance design criteria according to the following test standards:
 - a. ANSI/SPRI ES-1-98 Test Method RE-1 Test for Roof Edge Termination of Single-Ply Roofing Membranes: The fascia system shall be tested to secure the membrane to minimum of 100 lbs/ft in accord with the ANSI/SPRI ES-1-98 Test Method RE-1. Use the current edition of ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
 - b. ANSI/SPRI ES-1-98 Test Method RE-2 Pull-Off Test for Fascia: The fascia system shall be tested in accord with the ANSI/SPRI ES-1-98Test Method RE-2. Use the current edition of ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
- 4. The fascia product shall be approved for use in Miami-Dade County and has been designed to comply with Florida Building Code, including the High Velocity Hurricane Zone, Miami-Dade County NOA No. 03-0108.06 Expiration Date 12/11/08.
- 5. Performance Characteristics:
 - a. Extruded bar shall lock membrane, prevent wind pullback.
 - b. Injection molded EPDM splices to allow thermal expansion of extruded aluminum anchor bar.
 - c. Fascia shall freely thermal cycle on extruded bar, preventing periodic maintenance.
- 6. Fascia metal gauge: Contractor's option of .040" thick formed aluminum or 24 ga. galvanized steel.
- 7. Extruded bar: Shall be continuous 6063-T6 alloy aluminum at 12'-0" (3.65 m) standard lengths. All bar miters are welded.
- 8. Fasteners: #9 x 2" stainless steel fasteners provided with drivers. No exposed fasteners permitted.
- 9. All inside and outside corners to be manufactured corner pieces to eliminate seams.
- 10. Standard Face Height: Minimum 6 1/2", or manufacturers next larger size, unless noted otherwise on the drawings.

- B. Drip/Rake Edge:
 - 1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, and aesthetics of the following:
 - 1) Johns Manville Drip Edge
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Architectural Products Co.: www.archprod.com.
 - 2) OMG Roofing Products/OMG Edge Systems formerly W. P. Hickman: www.omgroofing.com
 - 3) Metal-Era Inc: www.metalera.com.
 - 4) Johns Manville: www.jm.com
 - 5) Metal Roofing Systems: www.metalroofingsystems.biz
 - 6) MM Systems Corp: www.mmsystemscorp.com
 - 7) Sika Saranfil: www.sarnafilus.com
 - 8) Siplast: www.siplast.com
 - 2. Drip/Rake Edge: Factory-fabricated 24 gauge galvanized steel, minimum 2 inch face, or manufacturers next larger size, painted finish, concealed joint covers, and continuous, galvanized anchor cleat.

2.02 ACCESSORIES

- A. Sealant: Type specified in Section 079005.
- B. Roof Cement: ASTM D4586/D4586M, Type I.
- C. General: Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.
- D. Exposed Fasteners: Stainless steel, nonmagnetic, of manufacturer's standard type and size for product and application indicated. Match finish of exposed heads with material being fastened.
- E. Concealed Fasteners: Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- G. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.
- H. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- I. Foam-Rubber Seal: Manufacturer's standard foam.
- J. Adhesives: Type recommended by manufacturer for substrate and project conditions, and formulated to withstand minimum 60-lbf/sq. ft. (2.9-kPa) wind-uplift force.

2.03 FABRICATION

- A. Roofing Contractor/Local Fabricator shop or field fabricated/broken fascia and drip edge will not be accepted.
- B. All roof edge components are to be designed and tested to meet ANSI/SPRI ES-1, and be fabricated in an ANSI/SPRI ES-1 approved fabrication facility.

2.04 FINISHES

- A. All exposed to view roof components specified above to have the following finish.
 - 1. All items to be the same color unless specifically noted.
- B. Finishes:
 - 1. High-Performance Organic Finish (2-coat Fluoropolymer): AA-C12C40R1X (Chemical Finish): cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Color to be selected from manufacturers standard color chart. Minimum twenty colors.
 - b. The following components to be painted; fascia.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Comply with NRCA (RM) drawing details as noted:
- C. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- D. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.
- E. Coordinate installation of flashing flanges into reglets.

END OF SECTION 077100

SECTION 077123 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured, Pre-finished galvanized steel or aluminum:
 - 1. gutters and downspouts
 - 2. Contractors option to provide either pre-finished aluminum, or pre-finished steel manufactured products.

1.02 RELATED REQUIREMENTS

A. Section 077100 - Manufactured Roof Specialties: Fascia

1.03 REFERENCE STANDARDS

- A. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- E. SMACNA (ASMM) Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.
- C. Product shall be listed in the current Factory Mutual Research Corporation Approval Guide approved for FM 1-90.

1.05 SUBMITTALS

- Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- B. Product Data: Provide data on prefabricated components.
- C. Selection Samples: For each item with a paint finish specified, submit color chips representing manufacturer's full range of available colors. Submit actual samples not photo reproductions.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials that could cause discoloration, staining, or damage.

1.07 WARRANTY

- A. Finish Warranty: Manufacturer's 20-year finish warranty stating products to be free of corrosion, checking, crazing, chalking, discoloring, fading, oxidation, and that exposed finish surface will not peel, crack, chip, or spall.
 - 1. Excessive color change/fading greater than 5 NBS (Hunter) units and passing 5000 hrs per ASTM D 2249-85, ASTM D 2244 and ASTM D 822-85 respectively.
 - 2. Chalking shall not be less than a rating of No. 8 per ASTM D 659 and ASTM D 4214.

3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, aesthetics, and formulations of the following:
 - a. Metal-Era, Inc: Seal-Tite Gutter System; Profile IG-2.
 - b. Metal-Era, Inc.: Seal-Tite Closed Face Industrial Downspout
 - 2. Prefinished Formed-Aluminum Gutters, Downspouts, Conductor Heads, Scuppers:
 - a. Architectural Products Co.: www.archprod.com
 - b. ATAS International, Inc.: www.atas.com
 - c. DMI: www.dmimetals.com
 - d. Englert Inc.: www.englertinc.com
 - e. IMETCO/Innovative Metals Company, Inc:
 - f. W.P. Hickman Co.: www.wph.com
 - g. Metal-Era, Inc.: www.metalera.com
 - 1) Private labeled components manufactured by Metal-Era:
 - (a) Carlisle
 - (b) Johns Manville
 - (c) Siplast
 - (d) Firestone
 - (e) Soprema
 - h. Roof Drainage Components & Accessories, Inc.: www.rdcaa.com
 - i. Southern Aluminum Finishing Co.: www.saf.com

2.02 MATERIALS

- A. Pre-Finished Galvanized Steel Sheet: ASTM A 653/A 653M, with G90/Z275 zinc coating gauge inch as indicated below:
 - 1. Downspouts: 24 gauge.
 - 2. Gutters: 24 gauge.
- B. Pre-Finished Aluminum Sheet: ASTM B 209 (ASTM B 209M); gauge inch as indicated below:
 - 1. Downspouts: 0.050 inch.
 - 2. Gutters: 0.050 inch.

2.03 COMPONENTS

- A. Gutters: SMACNA rectangular style profile.
 - 1. Manufacture in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories.
 - 2. Corners: Factory mitered and continuously welded.
- B. Downspouts: SMACNA Rectangular profile.
 - 1. Manufacture in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories.
 - 2. Provide with factory fabricated mitered elbows where spilling to grade, or into downspout boot.
- C. Gutter and Downspout Anchors and Supports:
 - 1. Gutter Supports: Straps and Hangers. 1 inch wide, 0.050 inch thick internal aluminum strap at 30 inch on center at top of gutter. Alternate location with 1 inch wide 0.125 inch thick external hanger at bottom location 30 inch on center for support of gutter.
 - a. Basis of Design: Metal-Era Seal-Tite IG-2 Industrial Gutter Support Bracket

- 2. Downspout Supports: Straps. Provide three anchor straps per 10 foot section.
 - a. Basis of Design: Metal-Era Style 1 Downspout Wall Bracket.
- D. Fasteners: Galvanized steel, with soft neoprene washers.

2.04 ACCESSORIES

A. Wire Ball Downspout Strainer: Provide a wire ball downspout strainer at every downspout location.

2.05 FABRICATION

- A. Roofing Contractor/Local Fabricator shop or field fabricated/broken gutters and downspouts will not be accepted.
- B. Form gutters and downspouts of profiles and size indicated.
- C. Fabricate with required connection pieces.
- D. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- E. Hem exposed edges of metal.
- F. Fabricate gutter and downspout accessories; seal watertight.

2.06 FINISHES

- A. All exposed to view roof components specified above to have the following finish.
 - 1. All items to be the same color unless specifically noted.
- B. Finishes:
 - 1. High-Performance Organic Finish (2-coat Fluoropolymer): AA-C12C40R1X (Chemical Finish): cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Color to be selected from manufacturers standard color chart. Minimum twenty
 - b. The following components to be painted; gutter and downspout.

PART 3 EXECUTION

3.01 EXAMINATION

- Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

3.02 PREPARATION

A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Slope gutters 1/8 inch per foot, 1 percent minimum.
- C. Provide expansion joints for gutter runs exceeding 40 feet.

- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- E. Connect downspouts to downspout boots above grade. Grout connection watertight.
- F. Refer to Section 334993 for downspout boots and splashblocks.
- G. Refer to site drainage drawings for downspout boot and splashblock locations.

END OF SECTION 077123

SECTION 077200 - ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof hatches.
- B. Roof hatch guardrail and gate system.
- C. Ships ladder safety post.

1.02 RELATED REQUIREMENTS

- A. Section 075200 Modified Bituminous Membrane Roofing.
- B. Section 077100 Manufactured Roof Specialties: Other manufactured roof items.
- C. Section 077123 Manufactured Gutters and Downspouts.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- C. FM (AG) FM Approval Guide; Factory Mutual Research Corporation; current edition.
- D. UL (DIR) Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- B. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
- C. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.06 PRODUCT WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty for hatches and accessories.

1.07 ROOF SYSTEM WARRANTY

A. Refer to roofing membrane section 075200 for Special Project Full System Warranty requirements for items to be included from this specification section.

PART 2 PRODUCTS

2.01 ROOF HATCHES

- A. Roof Hatches:
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but not limited to the following:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) Bilco Company: Roof Hatches Type F-50TB
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - 1) Acudor Products Inc: www.acudor.com.
 - 2) Babcock-Davis: www.babcockdavis.com.
 - 3) Tyman Plc/Amesbury Truth/Bilco Company: www.bilco.com.
 - 4) Dur-Red Products: www.dur-red.com.
 - 5) Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - 6) Precision Ladders, LLC: www.precisionladders.com

B. Roof Hatches

- 1. Roof Hatches, General: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 - Mounting: Provide frames and curbs suitable for mounting conditions as indicated on drawings.
 - b. For Ships Ladder Access: Single leaf; 48 x 48 inches.
- 2. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting. Interior and exterior surfaces to be thermally broken to minimize heat transfer and resist condensation.
 - a. Material: Mill finished aluminum, 11 gage, 0.0907 inch thick.
 - b. Insulation: Manufacturer's standard; minimum 1 inch rigid glass fiber or polyisocyanurate insulation, located on outside face of curb.
 - c. Curb Height: 12 inches from finished surface of roof, minimum.
- 3. Metal Covers: Flush, insulated, hollow metal construction. Interior and exterior surfaces to be thermally broken to minimize heat transfer and resist condensation.
 - a. Capable of supporting 40 psf live load.
 - b. Material: Mill finished aluminum; outer cover 0.125 inch/11 gage thick, liner 0.04 inch/18 gage thick.
 - c. Insulation: Manufacturer's standard minimum3 inch rigid polyisocyanurate or polyisocyanurate insulation.
 - d. Gasket: EPDM, continuous around cover perimeter.
- Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
 - a. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 - b. Hinges: Heavy duty pintle type.
 - c. Hold open arm with vinyl-coated handle for manual release.
 - d. Latch: Upon closing, engage latch automatically and reset manual release.
 - e. Manual Release: Pull handle on interior.
 - f. Locking: Padlock hasp on interior.
 - 1) Lock to be provided by Owner.

2.02 ROOF HATCH SAFETY RAIL AND SAFETY POST

- A. Contractor's option to provide a combination roof hatch, integral roof hatch safety rail and safety post system, or separate roof hatch, freestanding roof hatch safety rail and safety post system.
 - 1. Manufacturers Freestanding Roof Hatch Safety Rail: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiled, dimensional requirements and aesthetics of the following:
 - 1) Bluewater Manufacturing; Non-Penetrating Roof Hatch Railing SR2K.
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Bluewater Manufacturing: www.bluewater-mfg.com
 - 2) Garlock Safety Systems: www.railguard.net
 - 3) Kee Guard Railing: www.keesafetygroup.com
 - c. Freestanding Roof Hatch Safety Railing: Non-penetrating railing system with top rail, mid rail, and OSHA complaint swinging gate, with the hatch curb acting as the toe plate. System shall be capable of being dismantled for roof repair.
 - 1) System to support 200 lb., minimum in any direction for all components in accordance with OSHA Regulation 29 CFR 1910.23.
 - 2) Height: 42 inches, minimum.
 - 3) Width: Fit roof hatch. Refer to roof hatch information for hatch size.
 - 4) Railings: 1-5/8 inch O.D. hot rolled pickled electric weld tube, free of sharp edges and snag points.
 - 5) Mounting Bases: Class 30 gray iron material cast with four receiver posts. Provide rubber pads on bottom of bases.
 - 6) Posts: Shall have positive locking system into slots that allow rails to be mounted in any direction. Friction locking systems are not allowed. Receiver posts shall have drain holes.
 - 7) Railing Hardware: Securing pins shall be 101 carbon steel, zinc plated and yellow chromate dipped. Pins shall consist of collared pin and lanyard that connects to a lynch pin.
 - 8) Gate Hardware: Bolts and washers shall be 3/8 inch by 3-1/2", zinc plated.
 - 9) Gate Opener: Latch pole.
 - 2. Manufacturers Integral Roof Hatch, Safety Rail and Safety Post: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiled, dimensional requirements and aesthetics of the following:
 - SafetyPro LP: Model #SP-XXXX (refer to roof hatch specification information for hatch size(s) required):www.safeprosafety.com
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Babcock-Davis: www.babcockdavis.com
 - 2) Bilco Co.: www.bilco.com
 - 3) Acudor Products Inc.: www.acudoor.com
 - 4) Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - 5) Precision Ladders, LLC: www.precisionladders.com
 - 6) SafetyPro LP: www.safeprosafety.com
 - c. Roof Hatch Safety Railing: Tube system mounted on the roof hatch. Top and mid-rail and wrap around self-closing gravity gate mounted with heavy duty hinges.

- 1) System to support 200 lb., minimum in any direction for all components in accordance with OSHA Regulation 29 CFR 1910.23.
- 2) Height: 42 inches, minimum.
- 3) Width: Fit roof hatch. Refer to roof hatch information for hatch size.
- 4) Railings: 1-5/8 inch O.D. tube of either reinforced fiberglass, or steel, free of sharp edges and snag points.
- 5) Mounting System: Integrated stanchions of rail system through bolted to extended cap flashing of roof hatch.
- 6) Posts: Shall have positive locking system into slots that allow rails to be mounted in any direction. Friction locking systems are not allowed. Receiver posts shall have drain holes.
- 7) Railing Hardware: Securing pins shall be 101 carbon steel, zinc plated and yellow chromate dipped. Pins shall consist of collared pin and lanyard that connects to a lynch pin.
- 8) Gate System: Gravity self-closing, non collapsible full wrap around steel tubing of welded construction.
- d. Smoke Vent Safety Railing: Tube section mounted on the smoke vent.
 - 1) System to support 200 lb., minimum in any direction for all components in accordance with OSHA Regulation 29 CFR 1910.23.
 - 2) Height: 42 inches, minimum.
 - 3) Width: Fit smoke vent open ends. Refer to smoke vent information for vent size.
 - 4) Railings: 1-5/8 inch O.D. tube, free of sharp edges and snag points.
 - 5) Mounting System: Integrated stanchions of rail system through bolted to extended cap flashing of smoke vent.
 - 6) Posts: Shall have positive locking system into slots that allow rails to be mounted in any direction. Friction locking systems are not allowed. Receiver posts shall have drain holes.
 - 7) Railing Hardware: Securing pins shall be 101 carbon steel, zinc plated and yellow chromate dipped. Pins shall consist of collared pin and lanyard that connects to a lynch pin.
- 3. Manufacturers Safety Post: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiled, dimensional requirements and aesthetics of the following:
 - Extend-A-Rail for inclined ships ladders: www.precisionladders.com
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Bilco Co.: www.bilco.com
 - 2) Acudor Products Inc.: www.acudoor.com
 - 3) Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - 4) Precision Ladders, LLC: www.precisionladders.com
 - 5) SafetyPro LP: www.safeprosafety.com
 - Safety Post: Telescoping post permanently anchored to the top rung(s) of the ships ladder.
 - 1) Post to have adjustable mounting hardware to accommodate ladder rung size and spacing.
 - 2) Post to automatically lock in the fully raised position.
 - 3) Post to have release lever for lowering.
 - 4) Post to be steel with a bright safety color powder coat finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 077200

SECTION 078400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.
- C. Marking and identification of rated walls.
- D. The intent of the firestopping specification is for the entire project to have firestop products supplied by a single manufacturer, one firestop installing contractor and one firestop system warranty. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a completed certification form.

1.02 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard acoustic insulation.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) Directory of Listed Products; current edition.
- B. FM 4991 Approval Standard for Firestop Contractors; 2013.
- C. FM (AG) FM Approval Guide; current edition.
- D. SCAQMD 1168 South Coast Air Quality Management District Rule No.1168; current edition.
- E. UL (FRD) Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- B. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Installer Qualification: Submit qualification statements for installing mechanics.
- E. Manufacturer certificate, located at the end of this section, to be submitted with the bid, for the proposed firestopping systems confirming that the firestopping installer is approved to install the proposed fireproofing systems.
 - 1. The intent of this specification is for the entire project to have firestop products supplied by a single manufacturer, one firestop installing contractor and one firestop system warranty. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a certification form.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991.
 - 2. OR meeting the following requirements:
 - a. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified tested and listed system requirements.
 - b. Installation personnel shall be trained by the approved firestop manufacturer.
 - c. Installation personnel to have minimum 3 years documented experience installing work of this type.
 - d. Verification of at least five satisfactorily completed projects of comparable size and type.
 - e. Approved by firestopping manufacturer.
 - 3. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a certification form.
- D. Installing Mechanic's Qualifications: Trained by firestopping manufacturer and able to provide evidence thereof.
- E. Source Limitations: Obtain each type of sprayed fire-resistive material from one source by a single manufacturer.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

1.07 FIELD OUALITY CONTROL

- A. The Owner will employ an independent agency qualified to perform the testing indicated to verify that the firestopping meets the required specification per Chapter 17 of the 2015 International Building Code with KY Amendments. The Owner will be responsible to pay for testing during normal hours of business operation or non-overtime hours. Any testing expense incurred due to overtime work will be paid for by the installing Contractor. The installing Contractor shall notify the testing agency at least 24 hours prior to beginning any work that requires testing. Copies of all reports shall be forwarded to the Owner and Architect.
 - 1. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports as documented according to ASTM E 2174 and ASTM E 2393 and as required by the Kentucky Building code, latest edition
 - 2. Testing agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.
- C. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

1.08 WARRANTY

- A. Correct defective Work within a one year period after Date of Substantial Completion.
 - 1. Include coverage for firestopping to remain free from cracking, separation, and blistering.

2. Reinstall or repair failures that occur within warranty period.

PART 2 PRODUCTS

2.01 MATERIALS

A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.02 FIRESTOPPING SYSTEMS

- A. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches or less: Any material meeting requirements.
- B. Firestopping at Combustible Pipe and Conduit Penetrations, of diameter 4 inches or less: Any material meeting requirements.
- C. Firestopping at Cable Tray Penetrations: Any material meeting requirements.
- D. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Caulk or putty.
- E. Firestopping at Control Joints (without Penetrations): Any material meeting requirements.

2.03 MATERIALS

- A. Manufacturers: Subject to compliance with requirements the following products may be included in the work;
 - 1. A/D Fire Protection Systems Inc: www.adfire.com.
 - 2. 3M Fire Protection Products: www.3m.com/firestop.
 - 3. Hilti, Inc: www.us.hilti.com.
 - 4. Specified Technologies, Inc: www.stifirestop.com
 - 5. RPM Company TREM Fire Protection Systems Group: www.tremcofirestop.com
 - 6. Rectorseal Metacaulk: www.rectorseal.com
- B. Fire Safing: ASTM C 665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch. or as required to meet UL system detailed on drawings.
 - 1. Owens Corning Thermafiber SAFB: www.usg.com
 - 2. Roxul Inc. Roxul AFB: www.roxul.com
- C. Firestopping Sealants: Provide only products having lower volatile organic compound (VOC) content than 250 g/L.
- D. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
- E. Foam Firestoppping: Single component silicone foam compound; conforming to the following:
- F. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
- G. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening; conforming to the following:
- H. Firestop Devices Wrap Type: Mechanical device with incombustible filler and sheet stainless steel jacket, intended to be installed after penetrating item has been installed; conforming to the following:
- I. Firestop Devices Cast-In Type: Sleeve and sealing material, intended to be cast in concrete floor forms or in concrete on metal deck, not requiring any additional materials to achieve penetration seal.
- J. Intumescent Putty: Compound that expands on exposure to surface heat gain; conforming to the following:

K. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.04 MARKING AND IDENTIFICATION

- A. Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be permanently identified with signs or stencils.
- B. Locate identification in accessible floor, ceiling or attic spaces.
- C. Locate identification within 15 feet of the end of each wall and at intervals not exceeding 30 feet.
- D. Sign lettering to be not less than 3 inches in height with a minimum 3/8 inch stroke in a contrasting color Incorporating the wall name/rating wording.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install marking and identification required by code.

3.04 FIELD QUALITY CONTROL

A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 PROTECTION

- A. Clean adjacent surfaces of firestopping materials.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

SECTION 078400.01 - FIRESTOPPING MANUFACTURER'S CERTIFICATION

FIRESTOPPING MANUFACTURER'S CERTIFICATION

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

The intent of the firestopping specification is for the entire project to have firestop products supplied by a single manufacturer, one firestop installing contractor and one firestop system warranty. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a completed certification form.

| Date Submitted: | |
|--|---|
| Name & Address of Firestopping Manufacturer: | |
| | |
| | |
| Name & Address of Firestopping Installer: | |
| | |
| | |
| I certify that applicator of our Firestopping. | _ (Name of Firestopping Installer) is an approved |
| Signed: | _Title: |
| (Firestopping Manufacturer) | |

SECTION 079005 - JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

1.02 RELATED REQUIREMENTS

- A. Section 078400 Firestopping: Firestopping sealants.
- B. Section 088000 Glazing: Glazing sealants and accessories.
- C. Section 093000 Tiling: Sealant used as tile grout.
- D. Section 321373 Pavement Joint Sealants: Exterior sealants for horizontal pavements and surfaces.

1.03 REFERENCE STANDARDS

- A. ASTM C1330 Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).
- B. ASTM C834 Standard Specification for Latex Sealants; 2014.
- C. ASTM C919 Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- D. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1193 Standard Guide for Use of Joint Sealants; 2013.
- F. SCAQMD 1168 South Coast Air Quality Management District Rule No.1168; current edition.

1.04 SUBMITTALS

A. Product Data: Provide data indicating sealant chemical characteristics.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.06 PROJECT CONDITIONS

 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.08 WARRANTY

- A. Correct defective work within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1. Silicone, Polyurethane and Acrylic Sealants:
 - a. Dow Corning: www.dowcorning.com
 - b. Bostik Inc: www.bostik-us.com.
 - c. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - d. Pecora Corporation: www.pecora.com.
 - e. BASF Construction Chemicals-Building Systems: www.chemrex.com.
 - f. Tremco Global Sealants; Product: www.tremcosealants.com.
 - g. Sika Construction: www.sikaconstruction.com
 - h. Soudal Inc.: www.soudalusa.com
- B. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1. Preformed Compressible Foam Sealers:
 - a. EMSEAL Joint Systems, Ltd: www.emseal.com.
 - b. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
 - c. Dayton Superior Corporation: www.daytonsuperior.com.
 - d. Tremco Global Sealants: www.tremcosealants.com.
 - e. Sika Construction: www.sikaconstruction.com
 - f. Soudal Inc.: www.soudalusa.com

2.02 SEALANTS

- A. Sealants and Primers General: Provide only products having lower volatile organic compound (VOC) content than 250 g/L where applied within the waterproofing envelope.
- B. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
 - 1. Color: Standard colors matching finished surfaces.
 - 2. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Color: Standard colors matching finished surfaces.
 - 2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall and floor surfaces.
 - 1) Color at intersection of door frame bottom and resilient, sealed or coated flooring to match door frame color.
 - c. Other interior joints for which no other type of sealant is indicated.
- D. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
 - 1. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between kitchen and bath countertops and wall surfaces.

- E. Acoustic Sealant/Sound Caulk: Permanently tacky non-hardening acrylic sealant.
 - 1. Minimum 1/4 inch, continuous, sealant bead, both sides, of top stud runner and structure and bottom stud track and floor.
 - 2. Minimum 1/4 inch, continuous, sealant bead, around all openings, penetrations, and partition intersections.
- F. Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C920, Grade P, Class 25, Uses T, M and A; single component.
 - 1. Approved by manufacturer for wide joints up to 1-1/2 inches.
 - 2. Color: Standard colors matching finished surfaces.
 - 3. Applications: Use for:
 - a. Expansion joints in floors.

2.03 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O -Open Cell Polyurethane.
 - 2. Open Cell: 40 to 50 percent larger in diameter than joint width.
 - 3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
 - 4. Manufacturers:
 - a. ADFAST Corporation; ADSEAL BR-2600 (Backer Rod): www.adfastcorp.com#sle.
 - b. Nomaco, Inc; HBR: www.nomaco.com/#sle.
- D. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.

- C. Perform acoustical sealant application work in accordance with ASTM C919.
 - 1. Minimum 1/4 inch, continuous, sealant bead, both sides, of top stud runner and structure and bottom stud track and floor.
 - 2. Minimum 1/4 inch, continuous, sealant bead, around all openings, penetrations, and parition intersections.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.
- I. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- J. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect sealants until cured.

END OF SECTION 079005

SECTION 079513 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint assemblies for floor surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-Place Concrete: Expansion and contraction joints in junction of concrete slab-on-grade.
- B. Section 079005 Joint Sealers: Expansion and control joint finishing utilizing a sealant and bond breaker.

1.03 REFERENCE STANDARDS

- A. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- C. ASTM B308/B308M Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2010.
- D. ASTM B455 Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2010.

1.04 SUBMITTALS

- A. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- B. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- C. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

1.05 QUALITY ASSURANCE

A. Field Measurements: Verify compliance with manufacturer's requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Expansion Joint Cover Assemblies: Subject to compliance with requirements provide products by one of the following, but not limited to the following:
 - 1. Architectural Art Mfg., Inc: www.archart.com.
 - 2. Balco, Inc.: www.balcousa.com
 - 3. C/S Group; C/S Construction Specialties, Inc: www.c-sgroup.com.
 - 4. Inpro: www.inprocorp.com.
 - 5. MM Systems Corp; : www.mmsystemscorp.com/#sle.
 - 6. BASF/Watson Bowman Acme Corp.: www.wbacorp.com
- B. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1. Architectural Art Manufacturing Model #K-10-11-11 for interior floor to floor.

2.02 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 4. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
- B. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

2.04 FABRICATION

- A. Joint Covers: Aluminum cover plate, aluminum frame construction, designed to permit cover movement with full recovery, flush mounted.
- B. Provide joint components in single length wherever practical. Minimize site splicing.

2.05 FINISHES

Floors: Mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 PREPARATION

A. Install anchoring devices in conformance to templates.

3.03 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

3.04 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION 079513

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- Non-fire-rated hollow metal frames.
- B. Hollow metal frames for wood doors.
- C. Thermally insulated hollow metal doors with frames.
- D. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 061000 Rough Carpentry: Shims.
- B. Section 087100 Door Hardware.
- C. Section 088000 Glazing: Glass for doors and borrowed lites.
- D. Section 099000 Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.3 Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).
- D. ANSI/SDI A250.8 Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- E. ANSI/SDI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- F. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- G. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- H. ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- I. ASTM A924 Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.
- J. ASTM A 1008/A 1008M Standard Specification for Steel, sheet, Cold rolled, Carbon, High Strength Low-Alloy, High Strength Low Alloy with Improved Formability, Solution Hardened and Bake Hardenable.
- K. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- L. ASTM E413 Classification for Rating Sound Insulation; 2010.
- M. ICC A117.1 Accessible and Usable Buildings and Facilities; 2009.

- N. DHI A115 Series Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; 2000 (ANSI/DHI A115 Series).
- O. NAAMM HMMA 830 Hardware Selection for Hollow Metal Doors and Frames; 2002.
- P. NAAMM HMMA 831 Hardware Locations for Hollow Metal Doors and Frames; 2011.
- Q. NAAMM HMMA 820 TN01 Grouting Hollow Metal Frames
- R. NAAMM HMMA 820 TN03 Guidelines for Glazing of Hollow Metal Transom, Sidelight and Windows.
- S. NAAMM HMMA 840 Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- T. NAAMM HMMA 861 Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.
- U. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2016.
- V. NFPA 252 Standard Methods of Fire Tests of Door Assemblies; 2012.
- W. SDI 117 Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- SDI 111 Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
- Y. UL (BMD) Building Materials Directory; current edition.
- Z. UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- AA. UL 1784 Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
 - 1. Provide hollow metal frames from SDI Certified manufacturer.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Doors and Frames: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Steelcraft B-Series full flush, steel stiffened doors.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Curries, an Assa Abloy Group company: www.assaabloydss.com.
 - b. Custom Metal Products: www.custommetalproductsnc.com
 - c. Mesker, dormakaba Group: www.meskeropeningsgroup.com/#sle.
 - d. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - e. Ceco Door Products an Assa Abloy Group company: www.cecodoor.com.
 - f. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - g. Metal Products Inc. (MPI): www.metalproductsinc.com
 - h. Pioneer Industries: www.pioneerindustries.com

2.02 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush.
 - 6. Door Undercut: Manufacturer's standard, compatible with threshold configuration specified in section 087100.
 - 7. Interior Glazed Lights: Non-removable, square, stops on non-secure side. Size stops to accept 1/4 inch glass thickness. Refer to section 088000 Glazing for glass requirements.
 - Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 - 9. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
 - Grade: ANSI A250.8 Level 3, physical performance Level A, Model 1, full flush; 16 gage faces.

- 2. Core: Vertical steel stiffeners, 22 gage, spaced not to exceed six inches apart, fill between stiffeners with manufacturers standard extruded polystyrene insulation or batt insulation
- 3. Door Thickness: 1-3/4 inch, nominal.
- 4. Thickness: 1-3/4 inches.
- 5. Exterior Doors Top and Bottom Closures: Close top and bottom edges of doors flush as an integral part of the door construction or by the addition of 16 gage, metallic-coated steel channels with channel webs placed even with top and bottom edges.
 - a. Bottom closure is not required on doors with concealed automatic door bottoms.

 Provide manufacturers standard door bottom.
- 6. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
- 7. Door Face Sheets: Flush.
- 8. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
- 9. Weatherstripping: Refer to Section 087100.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. General:
 - 1. Comply with the requirements of grade specified for corresponding door, except:
 - a. Frames for Exterior Hollow Metal Doors: Comply with frame requirements specified in ANSI A250.8 Level 3 Doors: 14 gage frames.
 - b. Frames for Interior Wood and Hollow Metal Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 16 gage.
 - 2. Finish: Same as for door.
 - 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 - 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
 - 5. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
 - 6. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.
- C. Interior Door Frames at CMU Walls, Non-Fire-Rated and Fire-Rated: Fully welded type, seamless with joints filled.
 - 1. Fire Rating: Same as door, labeled.
 - 2. Wall Attachment: Lock-in masonry "T". Minimum three anchors per jamb.
- D. Interior Door Frames at Gypsum Board/Metal Stud Partitions Non-Fire-Rated and fire-Rated: Knock-down type, slip-on with mitered or coped corners for field assembly.
 - 1. Fire Rating: Same as door, labeled.
 - 2. Wall Attachment: Metal stud anchor/flush steel stud anchor. Minimum three anchors per jamb.
 - 3. Floor Attachment: Fixed base.
- E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- F. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- G. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 088000.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Double Doors: Specified in Section 087100.
- D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.07 FINISHES

- A. Manufacturer Installed Primer: Rust-inhibiting, complying with ANSI A250.10 one coat, baked-on rust inhibiting prime paint.
- B. Frame installer provided material Fibered Asphalt Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.
 - 1. When temperature conditions necessitate the use of anti-freezing agents in the mortar, the inside of the frame shall be coated per manufacturer recommendations.
 - 2. Material to be installed at factory by frame manufacturer or field applied.
 - 3. Single component, waterborne, modified asphaltic emulsion, VOC and HAPS free. Certified for use in fire-rated frames.
 - a. Spray applied: 5 mils WFT.
 - b. Dip applied: 3 mils DFT.
 - c. Solids: 57-63%
 - d. VOC's: 0
 - e. Finish: Semi-gloss, non-tacky.
 - f. Odor: None.
 - g. Flash Point: None.
 - h. HAPS: 0
 - 1) Basis of Design:
 - (a) Royal Coatings, Inc.: Royal PC Asphaltic Paint
 - (b) Steelcraft Frame Back Coating
 - (c) Equivalent submitted to Architect prior to issuance of the last addendum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Cold Weather Application: Frame installer to coat inside of frames that will be installed in masonry and filled with grout with anti-freeze additives prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- D. Install door hardware as specified in Section 087100.
- E. Comply with glazing installation requirements of Section 088000.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.
- B. Factory glazing of doors.

1.02 RELATED REQUIREMENTS

- A. Section 061000 Rough Carpentry: Installation of wood doors and hardware.
- B. Section 081113 Hollow Metal Doors and Frames.
- C. Section 087100 Door Hardware.

1.03 REFERENCE STANDARDS

- A. ASTM E152 Methods of Fire Tests of Door Assemblies.
- B. ICC (IBC) International Building Code; 2012.
- C. ITS (DIR) Directory of Listed Products; Intertek Testing Services/Warnock Hersey NA, Inc.; current edition.
- D. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2016.
- E. NFPA 252 Standard Methods of Fire Tests of Door Assemblies; 2012.
- F. UL (BMD) Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- G. UL 10B Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- H. WDMA I.S. 1A Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

- A. Product Data: Indicate door core materials and construction; thickness, veneer species, type and characteristics, cut and matching requirements, factory machining and factory finishing criteria. Provide glass size, type, pattern and thickness for factory glazed doors..
- B. Specimen warranty.
- C. Test Reports: Show compliance with specified requirements for the following:
 - Indicate compliance with specified fire rating (positive pressure or neutral pressure).
- D. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing
- E. Selection Samples: Submit samples representing manufacturer's full range of available colors. Submit actual samples not photo reproductions.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard and manufacturer's care and handling instructions.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.
 - HVAC system should be operational prior to arrival of doors. Acceptable humidity shall be no less than 25% or greater than 55%.

1.07 PROJECT CONDITIONS

A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.08 WARRANTY

- A. Provide manufacturer's warranty for the following term:
 - 1. Interior Doors: Life of installation.
- B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
- B. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Wood doors based on Masonite Architectural/Marshfield Door Systems.
 - 2. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Oshkosh Architectural Wood Doors: www.oshkoshdoor.com
 - b. VT Industries, Inc./Eggers Industries: www.vtindustries.com
 - c. Assa Abbloy/Graham Wood Doors: www.grahamdoors.com.
 - d. Masonite Architectural dba Algoma Hardwoods Inc., and Marshfield Door Systems : www.masonitearchitectural.com.

2.02 DOORS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Level: Custom Grade, "A" Grade Faces, Extra Heavy Duty performance, in accordance with WDMA I.S.1-A.
 - 2. Wood Veneer Faced Doors: 5-ply veneer and solid core unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); UL, or WH (ITS) labeled without any visible intumescent seals (Category A) when door is open.

2.03 DOOR CORES

A. Non-Rated Solid Core, Smoke, 20 and 45 Minute Rated Doors: Type: particleboard core (PC).

- 1. Door types: Flush (F), narrow view glass (NVG), narrow glass short (NGS), half-glass (HG) or other type indicated on the A6 drawings.
- B. Non-Rated Solid Core Doors: Type: structural composite lumber core (SCLC).
 - 1. Door Types: Full glass (FG1) or full glass with mid-rail (FG2).
- C. Fire Rated Doors: 60 and 90 minute rated doors with mineral core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
 - 1. Door types: Flush (F), narrow view glass (NVG) or other type indicated on the A6 drawings.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White birch, veneer grade in accordance with quality standard indicated, rotary cut, with book match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Same species as face veneer.
 - 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Core Blocking:
 - 1. Non-Rated Doors Flush (F), narrow view glass (NVG), narrow glass short (NGS), half-glass (HG) or other type indicated on the A6 drawings.
 - Provide solid blocks at lock edge, and top of door for closer for hardware reinforcement.
 - b. Provide solid blocking for other through-bolted hardware.
 - 2. Non-Rated Doors Full glass (FG1) or full glass with mid-rail (FG2).
 - a. Solid blocking not required.
 - 3. Rated Doors: Flush (F), narrow view glass (NVG) or other type indicated on the A6 drawings.
 - Single door Provide top blocking for closers, provide one mid-rail block or two lock blocks.
 - b. Pairs Provide bottom lock block.
 - 4. All Doors with Closers:
 - a. Provide top lock blocking.
 - b. Particleboard is not acceptable as blocking material.
- C. Fit door edge trim to edge of stiles after applying veneer facing.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY GLAZING - WOOD VENEER DOORS

- A. Glazing: Provided by wood door manufacturer as specified in Section 088000.
- B. Infill all nail holes, to match wood veneer color, both sides of glazing stops.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

- A. Factory finish doors in accordance with approved sample for a transparent finish. Color to be selected by Architect.
- B. Finish Type: Water based stain with UV resistant cured polyurethane sealer to comply with EPA Title 5 guidelines for VOC emmisions limitations or UV cured urethane per WDMA TR-8.
 - 1. Sheen: Satin Gloss.
 - 2. Testing: ANSI A161 1-1993 Section 9-3 Chemical Resistance.
 - a. Chemical Resistance: ANSI A161 1-1993 Section 9-3 Chemical Resistance.
 - b. Adhesion: ASTM D 3359 Method B to provide no loss of adhesion.
 - c. Water Resistance: Cellulose sponge containing 152 grams of water with no visible discoloration, staining, blistering or grain raise after 24 hours of exposure.

2.08 ACCESSORIES

- A. Glazing Stops: Non-fire-rated and 20 minute; Wood, of same species as door facing, mitered corners, flush beads/stops without reveal; prepared for countersink style nails or screws. Nail/screw holes to be filled with wood putty to match wood species. Sand filler smooth.
- B. Glazing Stops: Fire-rated doors 45 minute and above: Flush, wood veneer clad PVC or veneer wrapped rolled steel of same species as door facing. Provide glazing stops to match rating requirement of the door. Fire rated glazing to meet requirements of NFPA 80 to ensure all fire doors have a completed opening that meets all fire rating requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.02 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION 081416

SECTION 083100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Access door and frame units, non-fire-rated, in wall locations.

1.02 RELATED REQUIREMENTS

- A. Section 092116 Gypsum Board Assemblies: Provide framed openings in partitions for access panels.
- B. Section 099000 Painting: Field paint finish.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) Directory of Listed Products; current edition.
- B. UL (FRD) Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- B. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- C. Manufacturer's Installation Instructions: Indicate installation requirements.
- D. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Access Doors: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the Work include, but are not limited to the following:
- B. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, and aesthetics of the following:
 - 1. Acudor Products, Inc: www.acudoor.com
 - a. Non-Fire Rated Walls Acudor Products DW-5040
- C. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1. Architectural Products Co.: www.archprod.com.
 - 2. Acudor Products Inc: www.acudor.com.
 - 3. Cendrex: www.cendrex.com
 - 4. Morris Group International/Elmdor Stoneman: www.elmdorstoneman.com
 - 5. Karp Associates, Inc: www.karpinc.com.
 - 6. Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - 7. Morris Group International/Larsen's Manufacturing: www.larsenmfg.com
 - 8. Babcock Davis: www.babcockdavis.com
 - 9. J. L. Industries: www.jlindustries.com

2.02 ACCESS DOORS AND PANELS

A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.

2.03 ACCESS DOOR UNITS

- A. Door and Frame Units: Formed steel.
 - 1. Frames and flanges: 0.058 inch (16 gage minimum) continuous welded steel.
 - a. Grind all welds smooth and flush with adjacent surfaces.
 - 2. Door panels: 0.070 inch (14 gage minimum) single thickness, continuous welded, steel sheet.
 - a. Grind all welds smooth and flush with adjacent surfaces.
 - 3. Trim in gypsum board partitions: Galvanized drywall bead.
 - 4. Sizes:
 - a. Walls: 12 inch X 12 inch in gypsum board.
 - 5. Hardware:
 - a. Hinges for Non-Fire-Rated Units: Concealed.
 - b. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
 - 6. Prime coat with alkyd primer.

2.04 FABRICATION

A. Weld, fill, and grind joints to ensure flush and square unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

SECTION 083500 - SECURITY GRILLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Side-folding aluminum grilles.
- B. Operating hardware and supports.

1.02 RELATED REQUIREMENTS

- A. Section 061000 Rough Carpentry: Wood blocking.
- B. Section 08 7100 Door Hardware: Cylinder cores and keys.
- C. Section 092116 Gypsum Board Assemblies: Wall construction.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM) B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.04 PERFORMANCE REQUIERMENTS

- A. Manufactured grill pocket to fit flush within a 6 inch steel stud wall.
- B. All locking posts shall allow for horizontal sway without pressure to side walls of track from trollies while opening and closing the curtain.
- C. All post's standard locking hardware and handles shall be flush within post with exceptions for exit hardware.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate track layout and dimensions including pocket, required curves, types and locations of posts, required locking and hardware, options, finish and installation details.
- B. Product Data: Provide information on grille construction, components, materials, and finishes.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Data

1.06 WARRANTIES

A. Provide manufacturer's 2 year warranty against defects in materials and workmanship from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following::
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Dynamic Closures Corporation: EZ Grille: www.dynamicclosures.com
 - Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - a. CHI Overhead Doors. (www.chiohd.com)
 - b. Overhead Door Corp. (www.overheaddoor.com)
 - c. Wayne-Dalton Corp. (www.wayne-dalton.com)

SECURITY GRILLES 083500 - 1

 Equivalent product submitted to the Architect for approval prior to issuance of the last addendum.

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B221, 6063-T5 or T6 alloy and temper.

2.03 COMPONENTS

- A. Security Grill Curtain:
 - 1. 4.25 inches wide with 2 inch high bottom and top plates, truss-like aluminum.
 - 2. Panels connected with 1/8 x 5/8 x 4-1/4 inch aluminum links vertically spaced 15 inches apart onto 5/16 inch aluminum horizontal rods spaced 3-1/2 inches on center and covered by 1/2 inch aluminum tubes. Curtain secured to pocket, not end post required.
 - 3. Pattern: Straight
- B. Pocket: To fit flush within a 6 inch steel stud wall. Welded .5 inch tubular steel frame forming 6 inch exterior with 1 inch vertical adjustment. Grilles to fit within 5 inch clear opening of pocket. Pocket door clear anodized aluminum with full height integrated handle.
- C. Operation: Manual push/pull.
- D. Curtain Carriers: Dual bearing trolleys with 1.125 inch diameter tires.
- E. Overhead Track: Extruded aluminum, 1.375 inches wide x 1.675 inches high, continuous profile seamed with alignment bars and track pins at splices.
- F. Locking Post: Extruded aluminum, all post's standard locking hardware and handles shall be flush within post.
 - 1. Locks to be located on the public side.
 - 2. Wall Channel: A floor to track extruded aluminum channel that the hookbolt fits and locks into. This channel is secured permanently to the wall.
 - 3. HookBolt Lead: This post has a hookbolt that secures it to the Wall Channel. Additional top locking or double hookbolt locking available.
 - Traveling End: The Traveling End post terminates a door inside of a pocket (storage area). It is free to travel back and forth inside of the pocket. The post self-locks into permanent header and floor stops that prevent the door from fully leaving the pocket. A rear flange attached to the back of the post prevents reaching around.
 - Fixed End: Simply attaches the end of a door permanently to a wall of structure

2.04 FINISHES

A. Aluminum: Clear anodized standard.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install assembly in accordance with manufacturer's instructions.
- B. Anchor to adjacent construction without distortion or stress, level and plumb, to provide smooth operation.

3.02 ADJUSTING

A. Adjust grilles for smooth operation throughout full operating range.

END OF SECTION 083500

SECURITY GRILLES 083500 - 2

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.
- D. Perimeter sealant.
 - 1. Perimeter caulking at interior and exterior wall veneer/substrate.
 - 2. Perimeter expandable spray foam insulation to be installed between exterior veneer/substrate and wood storefront anchorage blocking at frame surround to prevent wall cavity air to infiltrate the back side of the storefront framing.

1.02 RELATED REQUIREMENTS

- A. Section 051200 Structural Steel Framing: Steel attachment members.
- B. Section 055000 Metal Fabrications: Steel attachment devices.
- C. Section 079005 Joint Sealers: Perimeter sealant and back-up materials.
- D. Section 087100 Door Hardware: Hardware items other than specified in this section.
- E. Section 088000 Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; 2012.
- C. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- E. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- F. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- G. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- H. ASTM E330/E330M Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- I. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - 1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

- B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E 283.
- D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft.
- E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

1.05 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- C. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
 - 1. Engineering calculations as described are required by Ross-Tarrant Architects, whether or not the listed manufacturers require engineered calculations.

1.06 OUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. General Contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total storefront system installation. Correct defective Work within a one year period after Date of Substantial Completion.

- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, gloss reduction, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Storefront: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Exterior Storefront: EFCO Series 403 Flush Glazed Thermal Screw Spline Storefront.
 - b. Interior Storefront: EFCO Series 402 Flush Glazed Non-Thermal Screw Spline Storefront with glazing adaptors.
 - c. Exterior Entrance Doors: EFCO Series D500 Wide Stile Entry Door.
 - d. Interior Entrance Doors: EFCO Series D500 Wide Stile Entry Doors.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Storefront:
 - 1) Apogee Enterprises, Inc./EFCO Corporation: www.efcocorp.com
 - 2) Graham Architectural Products: www.grahamwindows.com
 - 3) Kawneer North America: www.kawneer.com.
 - 4) Manko Window Systems, Inc: www.mankowindows.com.
 - 5) Oldcastle Building Envelope/Vistawall Architectural Products/CRL(C. R. Laurence)/United States Aluminum: www.oldcastlebe.com.
 - 6) Peerless Products, Inc.: www.peerless-usa.com
 - 7) YKK AP America Inc: www.ykkap.com.
 - 8) Trulite Glass and Aluminum Solutions: www.trulite.com
 - 9) Apogee Enterprises/Tubelite, Inc.: www.tubeliteinc.com.

2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Position: Centered (front to back).
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
 - 3. Air Infiltration Test Pressure Differential: 1.57 psf.
 - 4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 - 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.

9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:

- Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
- 3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
- 4. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- 5. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
- 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing Stops: Flush.
- B. Doors: Glazed aluminum, wide stile.
 - 1. Thickness: 1-3/4 inches.
 - 2. Top Rail: 5 inches wide, minimum.
 - 3. Vertical Stiles: 5 inches wide, minimum.
 - 4. Mid Rail: 6 inches wide, 5 inches minimum.
 - 5. Bottom Rail: 10 inches wide, minimum.
 - 6. Glazing Stops: Square.
 - a. Exterior Glazed Lights: Non-removable stops on non-secure side. Glazing pocket to accept a 7/8 inch total thickness insulated unit. Size stops in accordance with specified glass thickness. Refer to section 088000 Glazing for glass requirements.
 - b. Interior Glazed Lights: Non-removable stops on non-secure side. Size stops and glazing pocket to accept 1/4 inch glass thickness. Refer to section 088000 Glazing for glass requirements.
 - 7. Finish: Same as storefront framing.
- C. Sill Receptor, Sill Subframe and Sill Extension: Receptors, subframes and extensions are required for all exterior aluminum storefront system whether specifically shown/detailed on the architectural storefront details or required by the manufacturer to meet the aluminum storefront system warranty.
 - 1. General: Receptors, extensions and subframes to be an extruded, thermally broken, aluminum, receiver type sill receptor or subframe with a minimum thickness of .063" as indicated on the drawings. Extensions to be extruded aluminum with a minimum thickness of .063" depth as indicated on the drawings. Assembly shall not require the use of exposed fasteners or rivets. All exposed to view edges shall be hemmed. Color and finish to match aluminum storefront frame.

- 2. Sill Receptor: Set receptor in a continuous bed of sealant to insure watertight seal with exterior wall components. Sill receptor shall return up the back of the storefront sill in the interior of the room and be one continuous piece the full depth of the storefront sill. Outside edge of sill receptor to have built-in drip edge. Provide receptor in one continuous piece the full width of the storefront opening. If storefront opening width exceeds the limits for one continuous piece receptor then provide a splice joint sealed with 4" wide, self-adhering flashing tape and sealant to provide a watertight splice per manufacturers requirements. Provide receptor with mechanically attached, end dams/caps that have been sealed with a self-adhering sheet product or sealant to provide a watertight condition.
 - a. Basis of Design:Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) Sill Receptor: EFCO Corporation: 2G90 thermally broken sill receptor: www.efcocorp.com.
 - 2) Self-Adhering Flashing Tape: W. R. Grace; Perma-Barrier Tape (EFCO Corporation; #WM01)
- 3. Sill Subframe: Provide subframe, in addition to the sill receptor, at areas where the storefront is sitting on the interior concrete slab with flush exterior hard surface. Set subframe in a continuous bed of sealant to insure watertight seal with floor surface. Provide subframe in one continuous piece the full width of the storefront opening. If storefront opening width exceeds the limits for one continuous piece subframe then provide a splice joint sealed with 4" wide, self-adhering flashing tape and sealant to provide a watertight splice per manufacturers requirements. Provide subframe with mechanically attached, end dams/caps that have been sealed with a self-adhering sheet product or sealant to provide a watertight condition.
 - a. Basis of Design:Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - Sill Subframe EFCO: 1G64 thermally broken sill subframe: www.efcocorp.com
 - 2) Self-Adhering Flashing Tape: W. R. Grace; Perma-Barrier Tape (EFCO Corporation; #WM01)
- No field or shop fabricated brake metal sill receptors, subframes or extensions will be accepted.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum for Brake Metal: ASTM B209 (ASTM B209M). Minimum 0.040 gauge thickness. Prefinished sheet in color and gloss to match adjacent framing. Joints between brake metal and metal framing to be "hairline" in width. Provide "Z" clips to secure brake metal to metal framing. Provide sealant in all hairline joints, color to match adjacent framing color.
- C. Fasteners: Stainless steel.
- D. Perimeter Sealant: Type as specified in Section 079005.
- E. Glass: As specified in Section 088000.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.05 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 HARDWARE

- A. Other Door Hardware: As specified in Section 087100.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

2.07 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
 - 1. Install perimeter expandable spray foam insulation between exterior veneer/substrate and wood storefront anchorage blocking at frame surround to prevent wall cavity air from infiltrating the back side of the storefront framing.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.

- Provide expandable foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of sealant and secure.
- K. Install glass in accordance with Section 088000, using glazing method required to achieve performance criteria.
- L. Install perimeter sealant in accordance with Section 079005.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.05 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

END OF SECTION 084313

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware for the following swinging doors:
 - a. Aluminum.
 - b. Hollow metal.
 - c. Flush wood.
 - d. Existing.
 - 2. Key cylinders for doors specified in other Sections.
 - 3. Electrified access control door hardware. See Door Hardware Schedule and Door-Set Numbering Index (this Section) for hardware sets prefixed with "E" for required electrical work and materials. See electrical specifications for additional required electrical work and materials
 - 4. Low-energy ADA automatic door operators requiring electrical work and materials, and installation by AAADM certified installer.
 - 5. Retrofit work on existing doors and frames. See hardware sets prefixed with "R".
- B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC International Building Code.
 - 3. NFPA 70 National Electrical Code.
 - 4. NFPA 80 Fire Doors and Other Opening Protectives.
 - 5. NFPA 101 Life Safety Code.
 - 6. NFPA 105 Smoke and Draft Control Door Assemblies.
 - 7. APPLICABLE STATE BUILDING CODE.
 - 8. UL 10C Fire Tests of Door Assemblies
 - 9. UL 305 Panic Hardware

1.2 SUBMITTALS

- A. Number of Submittals: All items listed in this section are to be included in one submittal prepared by one Supplier.
- B. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Factory-drawn Wiring Diagrams: Hardware submittals without these diagrams will be rejected without review. Power, signal, and control wiring. Include the following:
 - a. All diagrams labeled with door numbers and hardware sets.
 - b. Point-to-point wiring diagram identifying specific termination points for all electrified hardware items.
 - c. Riser diagrams indicating required electrical junction boxes and mounting boxes, conduit paths with number of conductors and wire gauges required.

- d. Elevation of each door indicating where items are located with respect to which side of opening, dimension above floor, and lateral and vertical distances from opening.
- e. System function description for each electrified opening.

D. Qualification Data:

- 1. Finish Hardware Installers: Company specializing in the installation of commercial door hardware with minimum of five years documented experience in commercial hardware installation.
- 2. Hardware Supplier
 - Established contract hardware firm which maintains and operates an office, display, and stock in project area and which is a factory authorized distributor of the lock being furnished.
 - b. Hardware detailed, scheduled and furnished by or under direct supervision an Architectural Hardware Consultant.
 - c. All schedules submitted to the Architect for approval and job use must carry the signature and certified seal of this Architectural Hardware Consultant.
- 3. Architectural Hardware Consultant
 - a. Currently certified by the Door and Hardware Institute.
 - b. Full-time employee of the Hardware Supplier or an individual having no contractual ties to any supplier/manufacturer entity.
 - c. Available at reasonable times to Architect, Owner, and Contractor during course of work.
- 4. Automatic Door Operator Supplier
 - a. Established automatic operator distribution and installation firm which maintains and operates an office, display, and stock in project area and which is a factory authorized distributor of the automatic operator being furnished.
 - b. Currently certified by AAADM to install both high and low energy automatic door operators.
 - c. All schedules submitted to the Architect for approval and job use must include copies of the distributors factory authorization to distribute and install their operators and AAADM certification to install both high and low energy automatic door operators.
- E. Maintenance Data Submittal: For each type of door hardware. Include final hardware schedule, keying schedule, product data sheets for each item, manufacturers' published warranties, riser diagrams, and point-to-point wiring diagrams.
- F. Warranty: Special warranty specified in this Section.
- G. Other Action Submittals:
 - 1. Door Hardware Sets: Prepared by or under the supervision of a DHI certified Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule"; other formats will be rejected without review. Double space entries, and number and date each page.
 - b. Provide index sorted by door number linking door numbers to hardware set numbers and hardware heading numbers.
 - c. Numerical Sequence of Sets and Headings: Submittal headings shall be in exact order as hardware sets in specification: one heading only per set. Submittal set numbers shall relate to specification set numbers, ie. if three headings are required for Set 12 due to door width differences, then the heading numbers should be 12.1, 12.2, and 12.3 or employing similar linking logic.
 - d. Door Numbers: Identical to those used in the contract documents.
 - e. Number of Copies: (5).
 - f. Content: Include the following information:

- 1) Identification number, location, hand, fire rating, and material of each door and frame.
- 2) Type, style, function, size, quantity, and finish of each door hardware item.
- 3) Complete designations of every item required for each door or opening including name and manufacturer.
- 4) Degree of opening for closer and overhead stop and holder installation.
- 5) Keying information.
- 6) Fastenings and other pertinent information.
- Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
- 8) Explanation of abbreviations, symbols, and codes contained in schedule.
- 9) Mounting locations for door hardware.
- 10) Notes included with specification hardware sets <u>transcribed verbatim</u> into submittal hardware sets and headings.
- 11) Door and frame sizes and materials.
- 12) Items referenced but not furnished.
- 13) System function description for each hardware set with electrified hardware.
- 14) List of related door devices specified in other Sections for each door and frame.
- g. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.
- 2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.3 QUALITY ASSURANCE

- A. Furnish proper hardware types and quantities for proper door function, hardware mounting and clearances, aesthetics, and to meet applicable codes. Bring discrepancies to the attention of the Architect a minimum of (10) days prior to bid date so that an addendum may be issued and costs included in the bid. No additional compensation will be allowed after bidding for hardware changes required for proper function, hardware mounting or clearances, aesthetics or to meet codes. The specification is not a detail from which products should be ordered; detailing the project is the responsibility of the Contract Hardware Supplier.
- B. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- C. Source Limitations: **All items listed in hardware sets are to be furnished by one supplier**. Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- D. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
 - 1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

- a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
- b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
- 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
- 4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
 - a. Test Pressure: Positive pressure labeling.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Conference is to include representatives of the Owner, Architect, Contractor, CM if applicable, Hardware Supplier, and Manufacturer of Key Cylinders. Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Deliver hardware for aluminum doors to GC in timely manner so as not to delay fabrication of aluminum doors and frames. Balance of hardware may be delivered to GC at same time, packaged separately from aluminum door hardware, and may be billed as stored materials.
- C. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- Deliver keys to Owner by registered mail or overnight package service. Obtain Owner's contact name and address from Architect.

1.5 COORDINATION

A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Distribute templates in a timely manner so as not to delay suppliers. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, and security system.
- C. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, contract hardware supplier shall field verify existing conditions and coordinate procurement and installation of door hardware to suit opening conditions, aesthetic matters of form and finish, issues of clearance, function and fitup with existing door and frame preps, and to provide for proper operation and code compliance.

1.6 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: Two years from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Seven years for heavy duty cylindrical (bored) locks and latches.
 - 3. Five years for panic/exit hardware.
 - 4. Twenty years for manual door closers.
 - 5. One year for automatic door operators.

1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

1.8 EXTRA MATERIALS

- A. Furnish full-size units of door hardware described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hardware:
 - a. (1) complete closer (heavy duty parallel arm)
 - b. (2) office function locksets

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
- B. Designations: Requirements for design, grade, function, material, finish, size and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products listed by model number establish a basis of design for that product genre. Other products manufactured by available manufacturers listed in other Part 2 articles may be provided as long as they are equal in all aspects to the basis of design product listed for that particular product genre.
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Standards: In addition to other requirements in this section, provide products complying with or exceeding these standards and requirements for description, quality, and function.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electrified access control door hardware, in compliance with specifications, must be submitted in writing prior to the bid date and in accordance with the procedures and time frames outlined in Division 01 "Substitution Procedures". Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 BUTT HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
 - 1. Two Hinges: For doors with heights up to 60 inches (1524 mm).
 - 2. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).
 - 3. Four Hinges: For doors with heights 91 to 120 inches (2311 to 3048 mm).
 - 4. For doors with heights more than 120 inches (3048 mm), provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

- C. Hinge Height, Width, and Weight: Unless otherwise indicated, provide the following:
 - 1. Doors with panic/exit devices or 3'6" or more in width: 5" high, heavy-weight hinges.
 - 2. Doors less than 3'6" in width: 4-1/2" high, standard-weight hinges.
 - 3. Width: 4-1/2" heavy-weight, 4" standard-weight, unless proper clearance requires a different width.
 - 4. Doors with Closers: Antifriction-bearing hinges.
- D. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Exterior and in-swinging restroom door hinges: Stainless steel, with stainless-steel pin.
 - 2. Balance of hinges: Steel, with steel pin.
- E. Hinge Options: Provide the following:
 - 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for reverse bevel lockable doors.
 - 2. Corners: Square.
 - 3. Number of knuckles: Three.
- F. Fasteners: Comply with the following:
 - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - 2. Wood Screws: For wood doors and frames.
 - 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
 - 4. Screws: Phillips flat-head. Finish screw heads to match surface of hinges.
- G. Template Hinge Dimensions: BHMA A156.7.
- H. Available Manufacturers:
 - 1. Hager Companies (HAG).
 - 2. Ives (IVE).
 - 3. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - 4. Stanley; Div. of DormaKaba (STA).
 - 5. PBB, Inc. (PBB)

2.3 CONTINUOUS HINGES

- A. Provide hinge of general series as indicated in hardware sets and of proper shape and model to suit door and frame configuration.
- B. Continuous, Pinless-Type Hinges: Extruded-aluminum, pinless, hinge leaves; with concealed, self-lubricating thrust bearings.
 - 1. Available Manufacturers:
 - a. Architectural Builders Hardware (ABH).
 - b. Hager Companies (HAG).
 - c. IVES Hardware; an Allegion Company (IVE).
 - d. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - e. National Guard Products (NGP).
 - f. Pemko Manufacturing Co. (PEM).

- g. Select Products Limited (SEL).
- h. Stanley; Div. of DormaKaba (STA).
- i. Zero International (ZRO).

2.4 ELECTRIC STRIKES

- A. Surface Mounted Rim Panic Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.
 - 1. Acceptable Manufacturers:
 - a. HES (HES) 9500/9600 Series.
 - b. Security Door Controls (SDC) 30 Series.
 - c. Trine (TRN) 4850 Series.
 - d. Von Duprin (VON) 6300 Series.
- B. Provide electric strikes with in-line (MOV) surge suppressors.

2.5 ELECTRONIC ACCESSORIES

- A. Request-to-Exit Motion Sensor: Request-to-Exit Sensors motion detectors specifically designed for detecting exiting through a door from the secure area to a non-secure area. Include built-in timers (up to 60 second adjustable timing), door monitor with sounder alert, internal vertical pointability coverage, 12VDC or 24VDC power and selectable relay trigger with fail safe/fail secure modes.
 - 1. Acceptable Manufacturers:
 - a. Security Door Controls (SDC).
 - b. Securitron Door Controls (SEC).
 - c. General Electric Security (GES).
 - d. Honeywell (HNW).
- B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. 3/4" or 1" pop-in design; SPDT contacts.
 - 1. Acceptable Manufacturers:
 - a. Flair Electronics; (FLR).
 - b. Equal approved prior to bid.
 - c. Interlogix.
 - d. GE Security.

2.6 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
 - 1. Levers: Cast.
 - a. Best 15 model with full angled return.
 - 2. Roses: Forged.
 - Best D model.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 - 3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.
- E. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended as needed to protect frame, finished to match door hardware set, and as follows:
 - 1. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 2. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.5.

2.7 MECHANICAL LOCKS AND LATCHES

- A. Lock Types: Provide mortise or bored locks as indicated by model number in the Hardware Schedule.
- B. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
 - 1. Bored Locks: BHMA A156.2.
 - 2. Mortise Locks: BHMA A156.13.
- C. Bored Locks: BHMA A156.2 Grade 1.
 - 1. Available Manufacturers:
 - a. Best; Div. of DormaKaba (BES).
- D. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13 Grade 1.

- 1. Available Manufacturers:
 - a. Best; Div. of DormaKaba (BES).

2.8 AUXILIARY LOCKS AND LATCHES

- A. Auxiliary Locks: BHMA A156.5, Grade 1.
 - 1. Available Manufacturers:
 - a. Best; Div. of DormaKaba (BES).

2.9 DOOR BOLTS

- A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Surface Bolts: Minimum 1-1/8-inch (29-mm) throw.
 - 2. Mortise Flush Bolts: Minimum 3/4-inch (19-mm) throw.
- B. Surface Bolts: BHMA A156.16, Grade 1.
 - 1. Flush Bolt Heads: Minimum of 1/4-inch-(6mm) x 1/2-inch- (13-mm-) bolts of stainless steel with minimum 12-inch- (305-mm-) long rod for doors up to 84 inches (2134 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2134 mm).
 - 2. Available Manufacturers:
 - a. Door Controls International (DCI).
 - b. Glynn-Johnson; an Allegion Company (GLY).
 - c. Hager Companies (HAG).
 - d. IVES Hardware; an Allegion Company (IVE).
 - e. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - f. Rockwood Manufacturing Company (ROC).
 - g. Trimco (TRI).
- C. Manual Flush Bolts: BHMA A156.16, Grade 1; designed for mortising into door edge.
 - 1. Available Manufacturers:
 - a. Door Controls International (DCI).
 - b. Glynn-Johnson; an Allegion Company (GLY).
 - c. Hager Companies (HAG).
 - d. IVES Hardware; an Allegion Company (IVE).
 - e. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - f. Rockwood Manufacturing Company (ROC).
 - g. Trimco (TRI).

2.10 EXIT DEVICES

A. Exit Devices: BHMA A156.3, Grade 1.

- B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- F. Removable Mullions
 - 1. BHMA A156.3.
 - 2. Key removable.
 - 3. Provide head cap spacers, angle brackets, and other mounting accessories as needed for proper mounting, and anchoring and support of screws, as needed for top jamb configuration.
 - 4. Provide mullion stabilizer sets for mullions at exterior openings.
- G. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 - 1. Operation: Rigid.
- H. Outside Trim: As specified in hardware sets; material and finish to match locksets, unless otherwise indicated.
 - 1. Match design for locksets and latchsets, unless otherwise indicated.
- I. Fasteners. Manufacturer's standard, except furnish sex bolts for attachments to doors, unless doors have sufficient hardwood or other blocking to properly secure all required screws.
- J. Shims: Provide shims if needed for clearance.
- K. Available Manufacturers for Panic Devices:
 - 1. Detex, Inc. (DTX)
 - 2. Precision Hardware; Div. of DormaKaba (PHI).
 - 3. Von Duprin; an Allegion Company (VON).
- L. Available Manufacturers for Removable Mullions:
 - 1. Detex, Inc. (DTX)
 - 2. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).
 - 3. Von Duprin; an Allegion Company (VON).

2.11 KEY CYLINDERS

- A. Cylinders: Provide cylinders for all devices requiring key cylinders to properly function: constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 - 1. Number of Pins: Seven.
 - 2. Keyway: Patented or non-patented as directed by Owner.
 - 3. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 - 4. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 5. Bored-Lock Type: Cylinders with tailpieces to suit locks.
- B. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Small-format Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- C. Construction Keying: Comply with the following:
 - 1. Construction Cores: Provide keyed brass construction cores that are replaceable by permanent cores for locking devices on exterior doors plus (4) extra. Provide 6 construction master keys.
 - a. Replace construction cores with permanent cores as directed by Owner.
- D. Supplemental Items: Provide cylinder spacers, collars, and correct cams as needed for proper function of locking devices.
- E. Available Manufacturers:
 - 1. Best; Div. of DormaKaba (BES).

2.12 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:
 - 1. Existing System: Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 - 2. Quantity: Provide the following:
 - a. Cylinder Change Keys: Three per cylinder.
 - b. Master Keys: Six per master.
 - c. Grand Master Keys: Six.
 - d. Great-Grand Master Keys: Five.
 - e. Control Keys: Two.
 - f. Construction Control Keys: Two.
 - g. Blanks: Fifty.

2.13 OPERATING TRIM

- A. Materials: Fabricate from stainless steel, unless otherwise indicated.
- B. Dimensions: All dimensions, shapes, fasteners, and other properties identical to models specified in hardware sets.

C. Push Plates:

1. 0.125" thick, Type 304 solid stainless steel, 4" or 8" wide as indicated by model number in hardware sets, 16" high (unless stile width requires different width), heavy bevel all (4) edges, 3/8" radius rounded corners, factory prepped for key cylinders and thumb-turns as required, countersunk for flush bevel-headed screws.

2. Dimensions:

- a. Top of plate to horizontal centerline of key cylinder: 5".
- Horizontal centerline of key cylinder to horizontal centerline of thumb-turn: as required per dimension of lock model.
- c. Lock-side edge of plate to vertical centerline of key cylinder: 2".

D. Pull Plates:

- 1. Plate: 0.050" thick, 4" wide x 16" high (unless stile width requires different width), bevel all (4) edges, 3/8" radius rounded corners, factory prepped for key cylinders and thumb-turns as required, countersunk for flush bevel-headed screws.
- 2. Grip: 1" wide, 8" CTC, Type 304 solid stainless steel, half-moon profile.
- 3. Dimensions:
 - a. Top of plate to horizontal centerline of key cylinder: 2".
 - b. Horizontal centerline of key cylinder to horizontal centerline of thumb-turn: as required per dimension of lock model.
 - c. Edge of plate to vertical centerline of key cylinder and grip: 2".
 - d. Top of plate to horizontal centerline of grip: 10".

E. Available Manufacturers:

- 1. Hager Companies (HAG).
- 2. Hiawatha (HIW).
- 3. Burns (BRN).
- 4. IVES Hardware; an Allegion Company (IVE).
- 5. Rockwood Manufacturing Company (ROC).
- 6. Trimco (TRI).

2.14 SURFACE CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
- C. Fasteners: Manufacturer's standard for arms, shoes and brackets. Sex bolts for fastening closers to doors, unless doors have sufficient hardwood or other blocking to properly secure all required screws.
- D. Mounting Accessories: Provide shoes, brackets, drop plates, spacers, etc., as needed for proper mounting of closers and arms to door and frame.
- E. Spring Size of Units: Provide field-sizable closers, adjustable for spring sizes 1-6, plus 50% extra spring power at spring size 6, to meet field conditions and requirements for opening force.
- F. Cylinders: 1-1/2" minimum diameter; cast iron or high-silicon alloy aluminum.
- G. Mounting Configuration: Unless otherwise indicated by model number in the hardware sets:
 - 1. Do not furnish closers capable of being mounted on the corridor side of doors.
 - 2. If tri-pack closers are furnished for regular arm applications, remove parallel arm shoe from closer box before delivering to job.
 - 3. Parallel Arm closers are to be manufacturer's double forged rigid models.
- H. Available Manufacturers and Series for Cam and Roller Surface Closers:
 - 1. Dorma (DRM); TS9315 series.
 - 2. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR): 421-CT series.
 - 3. Norton Door Controls; an ASSA ABLOY Group company (NOR): 2800ST series.
 - 4. Corbin-Russwin (COR): DC5200 series.
- I. Available Manufacturers and Series for Rack and Pinion Surface Closers:
 - 1. LCN Closers; an Allegion Company (LCN): 4040XP series.
 - 2. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR): 281 or 351 series.
 - 3. Corbin-Russwin (COR): DC8000 series.

2.15 AUTOMATIC DOOR OPERATORS

- A. Standard: Set up operator to comply with Low Energy BHMA A156.19 standard. Operator shall also be capable of complying with High Energy BHMA A156.10 standard with no additional equipment required other than safety sensors.
- B. Performance Requirements:
 - 1. Not more than 15 lbf (67 N applied)1 inch (25 mm) from latch edge of door to prevent stopped door from opening or closing.
 - 2. If power fails, not more than 30 lbf (133 N applied)1 inch (25 mm) from latch edge of door to manually set door in motion.
 - 3. Warranted for use on out-swinging exterior doors with the use of a supplemental stop.
- C. Operation: Power opening and spring closing; **power closing to get door latched when encountering resistance**. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

- D. Operating System: Electromechanical.
- E. Microprocessor Control Unit: Solid-state controls.

F. Features:

- 1. Adjustable opening and closing speed.
- 2. Adjustable opening and closing force.
- 3. Adjustable backcheck.
- 4. Adjustable latch speed.
- 5. Adjustable hold-open time of not less than 0 to 30 seconds.
- 6. Adjustable time delay.
- 7. Adjustable acceleration.
- 8. Obstruction recycle.
- 9. Provide lock interface relay when not specified as part of locking device power supply.
- 10. On/Off/HO switch on side, top or bottom of housing, as directed by Owner.
- G. Mounting: Surface mounted to top jamb.
- H. Mounting Accessories: Provide shoes, brackets, drop plates, spacers, etc., as needed for proper mounting of operators and arms to door and frame.
- I. Bollards:
 - 1. Of material, size, configuration and shape indicated.
 - 2. Material: Stainless steel.
 - 3. Available Manufacturers for Bollards:
 - a. Wikk Industries (WIK).

J. Actuators:

- 1. Wall Push-Plate Switch: Semiflush, wall-mounted, door control switch; of material, size, and shape indicated; weather resistant for exterior applications; mounted in recessed junction box. Provide engraved message as indicated.
- 2. Wall Touchless Switch: Semiflush, wall-mounted, door control switch of material, size and shape indicated; mounted in recessed junction box. Provide engraved message as indicated.
- 3. Material: Stainless steel.
- 4. Message: International symbol of accessibility and "Push to Open."
- 5. Available Manufacturers for Actuators:
 - a. BEA (BEA).
 - b. Wikk Industries (WIK).
- K. Automatic Door Operator Signage:
 - 1. Comply with BHMA A156.19.
 - 2. Consult Architect before applying signage to door.
- L. Available manufacturers for Automatic Door Operators:
 - 1. Besam SW200i series. (BSM).
 - 2. LCN Closers; an Allegion Company (LCN); Senior Swing series.
 - 3. Stanley Access Technologies (SAT); M-Force series.

2.16 PROTECTIVE TRIM UNITS

- A. Size:
 - 1. Width
 - a. Singles, and pairs with removable mullions or surface applied astragals: 2 inches (38 mm) less than door width on push side and 1 inch (13 mm) less than door width on pull side
 - b. Other pairs: 1 inch (13 mm) less than door width
 - 2. Height: as specified in door hardware sets; or, if constrained by door bottom rail height, 1" less bottom rail height.
- B. Fasteners: Manufacturer's machine or self-tapping countersunk screws.
- C. Metal Protective Trim Units: BHMA A156.6; beveled 4 sides; fabricated from 0.050-inch-(1.3-mm-) thick stainless steel.
- D. Available Manufacturers:
 - 1. Hager Companies (HAG).
 - 2. IVES Hardware; an Allegion Company (IVE).
 - 3. Hiawatha (HIW).
 - 4. Burns (BRN).
 - 5. Rockwood Manufacturing Company (ROC).
 - 6. Trimco (TRI).

2.17 MECHANICAL WALL AND FLOOR STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
 - 1. Provide wall stops for doors unless floor, overhead, or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Provide floor stops (and spacers if needed) of proper height and configuration to accommodate floor condition. Where floor or wall stops are not appropriate, provide overhead holders.
 - 2. Properties. Cast construction with fastener suitable for wall or floor condition.
 - 3. Available Manufacturers:
 - a. Hager Companies (HAG).
 - b. IVES Hardware; an Allegion Company (IVE).
 - c. Hiawatha (HIW).
 - d. Burns (BRN).
 - e. Rockwood Manufacturing Company (ROC).
 - f. Trimco (TRI).
- B. Wall and Floor mounted Combination Door Stops and Holders: BHMA A156.16, Grade 1.
 - 1. Properties: Heavy cast with adjustable holding force, self-compensating for changes up to \(\frac{1}{4} \) in vertical door position. **Provide 1" Z900.0 flush spacers finished to match adjoining substrates for clearance as needed.**
 - 2. Manufacturer and Model: Trimco 1283.

2.18 OVERHEAD STOPS AND HOLDERS

- A. BHMA A156.8, Grade 1. Template for maximum degree of opening before encountering obstruction.
- B. Available Manufacturers:

- 1. Architectural Builders Hardware Mfg., Inc. (ABH).
- 2. Glynn-Johnson; an Allegion Company (GLY).
- 3. Hager (HAG).
- 4. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
- 5. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).

2.19 SILENCERS

- A. Though not listed in the hardware sets, provide silencers for Hollow Metal and Wood Door Frameswhich do not have smoke, fire or weather seals: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame; three for single doors, two for paired openings.
- B. Available Manufacturers:
 - 1. Glynn-Johnson; an Allegion Company (GLY).
 - 2. Hager Companies (HAG).
 - 3. IVES Hardware; an Allegion Company (IVE).
 - 4. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - 5. Rockwood Manufacturing Company (ROC).
 - 6. Trimco (TRI).

2.20 DOOR GASKETING

- A. General: Provide continuous weather-strip gasketing on exterior hollow metal doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners as indicated by models in hardware sets.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. If hardware is to be attached to the frame and would interfere with the gasketing, then provide hardware compatible gasketing that does not need to be cut for the mounting of hardware.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - 3. Mullion Gasketing: Fasten to mullions, forming seal when doors are closed.
 - 4. Sweeps: Apply to bottom of in-swinging exterior hollow metal doors, or as required for sound attenuation, forming seal with threshold or floor when door is closed.
 - 5. Seals integral to threshold at out-swinging exterior hollow metal doors.
- B. Requirements per type of rated door provided (these requirements supersede models indicated in hardware sets):
 - 1. Category A wood doors: provide models indicated in hardware sets.
 - 2. Category B wood doors: provide Category G&H seals at jambs and meeting edges. If Category H seals are indicated in hardware sets, provide Cat G seals in addition to the Category H seals.
 - 3. Category A and B hollow metal doors: provide models indicated in hardware sets.
- C. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

- 1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.
- E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 or UBC Standard 7-2.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.
- F. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- G. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- H. Jamb Gasketing Materials:
 - 1. Adhesive Seals. As specified in hardware sets or approved equal.
 - 2. Intumescents: As required.
 - 3. Screwed-on weatherstrip and sweeps. Neoprene.
 - 4. Panic type thresholds. Neoprene.
- I. Available Manufacturers for Jamb Gaskets (provided they provide items with neoprene inserts):
 - 1. Hager Companies (HAG).
 - 2. National Guard Products (NGP).
 - 3. Pemko Manufacturing Co. (PEM).
 - 4. Reese Enterprises (REE).
 - 5. Zero International (ZER).

2.21 THRESHOLDS

- A. Standard: BHMA A156.21
- B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.
- D. Fasteners: 1/4-20 machine screws and expansion anchors.
- E. Gasketing material: At panic-type thresholds: neoprene.
- F. Available Manufacturers (provided they provide items with neoprene inserts):
 - 1. Hager Companies (HAG).
 - 2. National Guard Products (NGP).
 - 3. Pemko Manufacturing Co. (PEM).
 - 4. Reese Enterprises (REE).
 - 5. Zero International (ZRO).

2.22 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Manufacturer's standard, except as noted in product sections of this specification.

2.23 FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION PRIOR TO INSTALLATION OF DOORS AND HARDWARE

- A. Prior to installing doors, examine frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance. Verify frames are plumb, level, square and dimensioned properly for the installation of doors.
- B. Prior to installing hardware other than hanging means, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction and other conditions affecting performance.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

- A. Low-energy Automatic Door Operators:
 - 1. Installer is to have current AAADM certification to install automatic door operators and actuating systems.
- B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Pulls: locate pulls as directed by Architect.
 - 4. Push Plates: Top edge of plate: 53"AFF.
 - 5. Pull Plates: Top edge of plate: 50" AFF. Centerline of Grip: 40" AFF.
 - 6. Key Cylinders for Auxiliary Deadbolts: 48" AFF.

C. Mounting Locations:

- 1. Floor Stops and Holders: Locate at least 20" out from hinge edge of door for maximum degree of opening before door encounters obstruction.
- 2. Wall Stops: Locate so that lockset spindle and wall stop share horizontal and vertical centerlines.
- 3. Wall Stop/Holders: Locate 4" down and in from top lock-edge corner of door w/holder slot at bottom of unit.
- 4. Closers and Overhead Stop/Holders: Template and mount closers and overhead stops for maximum degree of opening before door encounters obstruction or so as to interface with specified wall stops and holders. When used with closers, template and locate overhead stops so that closer arm does not fully extend and bottom out. These functionality requirements override any degree of opening information in the specifications or submittals.
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Hardware designed for mortised installation shall be mortised in flush with adjoining surfaces. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Weatherstrip and Gasketing with Metal Retainers: Fit up as needed for neat appearance with no gaps between retainers or bulbs. Mitre cut weatherstrip for flush fitup in corners.
- F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants." Position for complete seal with bottom of doors with no penetration of air or daylight.

3.4 FIELD QUALITY CONTROL

- A. Provide Door and Door Hardware Inspection Services as indicated below.
- B. Door and Door Hardware Inspection Services
 - 1. Scope
 - Inspection of all swinging doors and door hardware immediately following completion of installation.
 - b. Inspector to furnish a Field Quality Report, itemized per each individual opening, to the Architect within 7 days of the inspection, including:
 - 1) deficiencies in workmanship and standard industry practices,
 - 2) use of allowable products,
 - 3) use of manufacturer recommended fasteners,
 - 4) compliance with the ADA,
 - 5) improper door/frame/hardware clearances,
 - 6) problems related to function, security, aesthetics or maintenance.
 - 2. Inspector Qualifications
 - 1) Architectural Hardware Consultant.
 - 2) Entirely independent of the supply side of the project, having no familial or financial relationship with any manufacturer, manufacturer's representative, distributor, installer or supplier used on this project.
 - 3) Approved by Architect. Go to http://www.dhi.org/ for searchable list of local Architectural Hardware Consultants.
 - 4) Full member in good standing of Specification Consultants in Independent Practice (SCIP).
 - 5) Same Inspector for re-inspections as for the initial inspection.
 - 3. Payment for the inspection and subsequent re-inspections until work is complete and approved is to be made directly by the Hiring Entity to the Inspector within 30 days of receipt of report and invoice. The Hiring Entity responsible for contracting and paying this Inspector shall be that Entity responsibility for the installation or sub-contracting of all of the hardware installation for all products specified in this Section. Re-inspections are required until all work is complete and approved.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- B. Overhead Stops/Holders: Set adjustable stops for maximum degree of opening before door encounters obstruction. Adjust friction to control door.
- C. Wall and Floor Mounted Stop/Holders: Adjust holding force with spanner head wrench so that door is held securely yet is easy to pull out of hold open.
- D. Door Closers:
 - 1. Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
 - 2. Adjust latch period so that door does not slam nor injure fingers.

- 3. Adjust spring power so that door properly latches. Per the ADA, 5 lbf is the maximum allowed on an interior non-rated door; 8.5 lbf is the maximum allowed on a non-rated exterior door. On smoke or fire rated doors, adjust the closer to the minimum spring power needed to reliably latch the door. If the Installer is having difficultly properly adjusting the closer due to improper door-frame clearances or air pressure differentials, they are to immediately notify the Contractor so that corrections may be quickly made.
- 4. Adjust backcheck to not be noticeable when door is moving slowly, but to slow door down when accelerating due to human force or wind before hitting stop point so as to prevent damage to closer, arm, door, frame, and fasteners.
- E. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DOOR HARDWARE SCHEDULE (on following pages followed by Door-Set Index)

HARDWARE SET PREFIX KEY:

- E Indicates hardware set has electrified items.
- R Indicates hardware retrofit onto existing doors/or frames.

No prefix indicated hardware set has only mechanical items and all new doors and frames.

Hardware Set E01

| | Non-electrified Items: | | | |
|------|-----------------------------------|--|---------------|------------|
| (2) | Continuous Hinge, ALD | SL11HD | 628 | SEL |
| (1) | NS Panic Device, Rim, 01 | 2401LD | 630 | PHI |
| (1) | NS Panic Device, Rim, 03 | 2403LD | 630 | PHI |
| (1) | Rim Cylinder | | 626 | BES |
| (1) | Mortise Cylinder | | 626 | BES |
| (2) | Offset Pull, 18"CTC, 1-1/4"D | RM202 x Type 1XHD Mtg | 630 | ROC |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |
| | Note: Provide closer drop plate a | as required for top rail configuration. | | |
| (1) | Cat H Adhesive Mullion Mute | 5100 | Black | NGP |
| Note | e 1: ADA threshold, jamb and doo | r bottom and meeting edge seals by door su | pplier. | |
| | Electrified Items: | | | |
| (1) | Key Removable Mullion | KR-4954 x 154 x Angle Bracket | SP28 | VON |
| (1) | Mullion Wire Harness | MWH-5 | | TRN |
| (2) | Rim Panic Electric Strike | 4850 | 630 | TRN |
| (1) | REX PIR Sensor | MD-31D-W | White | SDC |
| | Note: Locate on push side, cente | red above opening. | | |
| (1) | Automatic Door Operator | SW200i | 628 | BSM |
| (1) | Actuator, Single-gang | S-SG-3-WR | 630 | WIK |
| | Note: Locate on exterior wall as | directed by Architect, 36"AFF. | | |
| (1) | Double-actuator, Dbl-gng | S-NAR-3LR | 630 | WIK |
| | Note: Locate on new Vestibule v | vall as directed by Architect. | | |
| (2) | Door Contact, Pop-in, DPDT | 1076D-G | Grey | Interlogix |
| (1) | Set: Riser and Point-to-point Wir | ing Diagrams. Include with Hardware Sub- | mittal for ap | proval. |

Set: Riser and Point-to-point Wiring Diagrams. Include with Hardware Submittal for approval.

(1) Lot: Single-gang card reader (located on exterior wall directly above operator actuator 44"AFF) and control electronics, low voltage power, low voltage cabling and terminations by Owner. Contractor to coordinate.

Electrical Notes:

Provide 120VAC, 60hz, 5A service to automatic operator. Provide 4x12 x16 junction box in concealed space as directed by Architect. Provide flush mounting boxes as indicated above for actuators, motion sensor and card reader. Provide conduit with pull strings from junction box to center of top jamb for electric strikes mounted on removable mullion, to mounting boxes, to automatic operator, and to door contacts on top jamb.

System Function:

Free egress at all times.

Open Hours: Electric strikes are powered (released) for free ingress. Pushing exterior actuator or left side of double-actuator signals automatic operator to open LHRB door leaf; door closes after time delay. Doors lock upon signal from access control system.

Closed Hours: Exterior operator actuator is disabled. Electric strikes are not powered and so doors are locked against ingress. Ingress by mechanical key through RHRB door leaf. Ingress by card which releases both electric strikes; during unlock period pushing exterior actuator signals automatic operator to open LHRB door leaf; doors close and relock after time delay. Actuator on left side of double-actuator is always enabled to signal automatic operator to release electric strikes and open LHRB door leaf. Doors unlock upon signal from access control system.

Hardware Set E02

Non-electrified Items:

| (2) | Continuous Hinge, ALD | SL11HD | 628 | SEL |
|-----|------------------------------|----------------------------------|-----|-----|
| | Offset Pull, 1-1/4"D, 18"CTC | RM202 x Type 1XHD Mtg | 630 | ROC |
| | Push Bar, 1-1/4"D, 32"CTC | RM350 x 32" | 630 | ROC |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |

Note: Provide closer drop plate as required for top rail configuration.

Note 1: Jamb and meeting edge seals by door supplier.

Note 2: Locate pulls and push bars at same height as pulls and panic devices on door pair ahead of this door pair.

Electrified Items:

| (1) | Automatic Door Operator | SW200i | 628 | BSM |
|-----|--|--------------------|-----|-----|
| (1) | Actuator, Jamb-mount | S-NAR-3 x JSB x WR | 630 | WIK |
| | Note: Locate on new mullion as directed by Architect, 36" AFF. | | | |

(2) Door Contact, Pop-in, DPDT 1076D-G Grey Interlogix

(1) Set: Riser and Point-to-point Wiring Diagrams. Include with Hardware Submittal for approval.

Electrical Notes:

Provide 120VAC, 60hz, 5A service to automatic operator. Provide conduit with pull strings from junction box specified for Door V100.1 to actuator and to automatic operator.

System Function:

Free egress and ingress at all times. Pushing actuator on right side of double-actuator or actuator on mullion in Lobby 100 signals automatic operator to open LHRB door leaf; door closes after time delay

Hardware Set R01

Non-electrified Items:

(2) Offset Pull, 18"CTC, 1-1/4"D RM202 x Type 1XHD Mtg 613E ROC

Retrofit Notes:

Remove existing pulls. Fill holes in aesthetically pleasing manner matching finish of doors. Install new pulls at height as located by Architect.

Hardware Set R02

Non-electrified Items:

| | y | | | |
|-----|------------------------------------|--------------------------------------|------|-----|
| (6) | Butt Hinge | AB700 x 4.5 x 4 | 641 | HAG |
| (2) | Offset Pull, 18"CTC, 1-1/4"D | RM202 x Type 1XHD Mtg | 613E | ROC |
| (2) | Push Bar, 1-1/4"D, 32"CTC | RM350 x 32" | 613E | ROC |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH | 695 | LCN |
| | Note: Provide closer drop plate as | required for top rail configuration. | | |
| (1) | Wall Stop, Convex | 1270CX | 613 | TRI |
| (1) | Cat H Astragal Set | 172NDKB | | NGP |
| | | | | |

Retrofit Notes:

Locate pulls and push bars at same height as pulls and panic devices on door pair ahead of this door pair. Re-attach arm of automatic operator to new RHRB door leaf.

Hardware Set R02A

Non-electrified Items:

| (6) | Butt Hinge | AB700 x 4.5 x 4 | 641 | HAG |
|-----|---|---|------|-----|
| (2) | Offset Pull, 18"CTC, 1-1/4"D | RM202 x Type 1XHD Mtg | 613E | ROC |
| (2) | Push Bar, 1-1/4"D, 32"CTC | RM350 x 32" | 613E | ROC |
| (1) | Closer, HD Parallel Arm | 4040XP EDA | 695 | LCN |
| | Note: Provide closer drop plate a | as required for top rail configuration. | | |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH | 695 | LCN |
| | Note: Provide closer drop plate as required for top rail configuration. | | | |
| (1) | Wall Stop, Convex | 1270CX | 613 | TRI |
| (1) | Cat H Astragal Set | 172NDKB | | NGP |
| | Datrofit Notes | | | |

Retrofit Notes:

Locate pulls and push bars at same height as pulls and panic devices on door pair ahead of this door pair. Re-attach arm of automatic operator to new RHRB door leaf.

Hardware Set R03

Non-electrified Items:

(6) Hinge Filler Plates for frame for 4.5" standard weight hinges.

Retrofit Notes:

Install hinge filler plates into frame hinge pockets. Fill, smooth and paint for new frame appearance.

Hardware Set R03A

Non-electrified Items:

(3) Hinge Filler Plates for frame for 4.5" standard weight hinges.

Retrofit Notes:

Install hinge filler plates into frame hinge pockets. Fill, smooth and paint for new frame appearance.

Hardware Set R04

Non-electrified Items:

| (2) | Continuous Hinge, Full Surface | 157XY | 628 | IVE |
|-----|--------------------------------|----------------------------|-----|-----|
| (1) | Panic Device, Mortise, 03 | 2303LD x 2103C (LHRBA) | 630 | PHI |
| (2) | Surface Bolt | 3923 | 626 | TRI |
| (1) | Mortise Cylinder | | 626 | BES |
| (1) | Closer, w/Spring Stop/HO | 4040XP SHCUSH | 689 | LCN |
| (1) | Overhead Holder, HD, Surface | 900H | 630 | GLY |
| (1) | Lock Guard, Mortise Lock | 5000T | 626 | TRI |
| (2) | Kick Plate | KO050 10 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Cat H Adhesive Astragal Liner | SA | DBN | DHS |
| (1) | Cat H Jamb Seal Set | 135NA | 628 | NGP |
| (2) | Door Bottom Sweep/Drip | C627A | 628 | NGP |
| (1) | ½" Saddle Threshold | 425 | 628 | NGP |

⁽⁶⁾ Hinge Filler Plates for frame for 4.5" standard weight hinges.

Note 1: Welded metal astragal on push side of inactive leaf by door supplier.

Note 2: Apply astragal liner to metal astragal for weather seal.

Retrofit Notes:

Install hinge filler plates into frame hinge pockets. Fill, smooth and paint for new frame appearance.

| Hai | edware Set R05 | | | |
|--|--|---|--|---|
| | Non-electrified Items: | | | |
| (3) | Butt Hinge | AB700 x 4.5 x 4 | 652 | HAG |
| ` / | Kick Plate | KO050 16 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Overhead Stop, HD, Surface | 900S | 630 | GLY |
| | Retrofit Notes: | | | |
| Re-i | nstall salvaged Best cylindrical locl | kset. | | |
| Hai | rdware Set R05A | | | |
| | Non-electrified Items: | | | |
| (3) | Butt Hinge | AB700 x 4.5 x 4 | 652 | HAG |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH | 689 | LCN |
| | | s required for top rail configuration. | | |
| (1) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| | Retrofit Notes: | | | |
| Re-i | nstall salvaged Best cylindrical locl | cset. | | |
| Hai | edware Set R06 | | | |
| | Non-electrified Items: | | | |
| (1) | Office Lock | 93K7AB15D-S3 | 626 | BES |
| (1) | Key Cylinder Core | | 626 | BES |
| | Retrofit Notes: | | | |
| Doo | r is already prepped for cylindrical | lockset. | | |
| Hai | dware Set R07 | | | |
| 1141 | | | | |
| | Non-electrified Items: | | | |
| (3) | Non-electrified Items: Butt Hinge | AB700 x 4.5 x 4.5 | 652 | HAG |
| (3) (1) | Non-electrified Items: Butt Hinge Push Plate | 1809-4 x RC | 630 | TRI |
| (3) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate | 1809-4 x RC 1014-3B x RC | 630 630 | TRI TRI |
| (3) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop | 1809-4 x RC 1014-3B x RC 4040XP SCUSH | 630 630 689 | TRI TRI LCN |
| (3) (1) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E | 630 630 | TRI TRI |
| (3) (1) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E | 630 630 689 | TRI TRI LCN |
| (3) (1) (1) (1) (1) Note | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. | 630 630 689 | TRI TRI LCN |
| (3) (1) (1) (1) (1) Note | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E | 630 630 689 | TRI TRI LCN |
| (3) (1) (1) (1) (1) Note | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E ll the way down. and finish for new frame appearance. | 630 630 689 | TRI TRI LCN |
| (3) (1) (1) (1) (1) Note | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. | 630 630 689 | TRI TRI LCN |
| (3) (1) (1) (1) (1) Note Rem | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E ll the way down. and finish for new frame appearance. | 630 630 689 630 | TRI TRI LCN TRI |
| (3) (1) (1) (1) (1) Note Rem Hai | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. | 630 630 689 630 | TRI TRI LCN TRI |
| (3) (1) (1) (1) (1) Note Rem (3) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. | 630 630 689 630 | TRI TRI LCN TRI HAG BES |
| (3) (1) (1) (1) (1) Note Rem (3) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. AB700 x 4.5 x 4.5 93K7AB15D-S3 | 630 630 689 630 652 626 626 | TRI TRI LCN TRI HAG BES BES |
| (3) (1) (1) (1) (1) Note Rem (3) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. AB700 x 4.5 x 4.5 93K7AB15D-S3 | 630 630 689 630 | TRI TRI LCN TRI HAG BES BES |
| (3) (1) (1) (1) (1) Note Rem (3) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. AB700 x 4.5 x 4.5 93K7AB15D-S3 | 630 630 689 630 652 626 626 | TRI TRI LCN TRI HAG BES BES TRI |
| (3) (1) (1) (1) (1) Note Rem (3) (1) (1) (1) (1) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave Edware Set 01A Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. AB700 x 4.5 x 4.5 93K7AB15D-S3 1270CV AB700 x 4.5 x 4.5 | 630 630 689 630 652 626 626 652 | TRI TRI LCN TRI HAG BES BES TRI |
| (3) (1) (1) (1) (1) Note Rem (3) (1) (1) (1) (1) (1) Hai (3) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave Edware Set 01A Butt Hinge Office Lock Office Lock Office Lock | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. AB700 x 4.5 x 4.5 93K7AB15D-S3 1270CV AB700 x 4.5 x 4.5 | 630 630 689 630 652 626 626 652 626 | TRI TRI LCN TRI HAG BES BES TRI HAG BES |
| (3) (1) (1) (1) (1) Note Rem (3) (1) (1) (1) (1) Hai (3) (1) (1) (1) | Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave Edware Set 01A Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. AB700 x 4.5 x 4.5 93K7AB15D-S3 1270CV AB700 x 4.5 x 4.5 93K7AB15D-S3 | 630 630 689 630 652 626 626 626 626 626 | TRI TRI LCN TRI HAG BES BES TRI HAG BES BES BES |
| (3) (1) (1) (1) (1) Note Rem (3) (1) (1) (1) (1) (1) (1) (1) (1) (1) (| Non-electrified Items: Butt Hinge Push Plate Pull Plate Closer, w/Spring Stop Kick Plate 1: Adjust closer's spring power al Retrofit Notes: ove existing strike from frame; fill Edware Set 01 Butt Hinge Office Lock Key Cylinder Core Wall Stop, Concave Edware Set 01A Butt Hinge Office Lock Key Cylinder Core Closer, Regular Arm | 1809-4 x RC 1014-3B x RC 4040XP SCUSH KO050 10 x 2LDW x CS x B4E Il the way down. and finish for new frame appearance. AB700 x 4.5 x 4.5 93K7AB15D-S3 1270CV AB700 x 4.5 x 4.5 93K7AB15D-S3 4040XP Reg | 630 630 689 630 652 626 626 626 626 626 626 689 | TRI TRI LCN TRI HAG BES BES TRI HAG BES BES LCN |

| Hardware Set 01B | | | |
|--------------------------------------|------------------------------|-----|-----|
| (3) Butt Hinge | AB700 x 4.5 x 4.5 | 652 | HAG |
| (1) Office Lock | 93K7AB15D-S3 | 626 | BES |
| (1) Key Cylinder Core | 75K/AD15D-55 | 626 | BES |
| | 7200 | | |
| (1) Universal Stop, 1-1/2" | 7280 | 630 | TRI |
| Hardware Set 01C | | | |
| (3) Butt Hinge | AB700 x 4.5 x 4.5 | 652 | HAG |
| (1) Office Lock | 93K7AB15D-S3 | 626 | BES |
| (1) Key Cylinder Core | 33K/AD13D-33 | 626 | BES |
| | V.0050 9 21 DW CC D4E | | |
| (1) Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) Wall Stop, Concave | 1270CV | 626 | TRI |
| Hardware Set 01D | | | |
| (3) Butt Hinge | AB750 x 5 x 4.5 | 652 | HAG |
| (1) Office Lock | 93K7AB15D-S3 | 626 | BES |
| · / | 33K/AD13D-33 | 626 | BES |
| (1) Key Cylinder Core | V0050 0 - 21 DW - CC - D4F | | |
| (1) Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) Wall Stop, Concave | 1270CV | 626 | TRI |
| Hardware Set 01E | | | |
| (1) Continuous Hinge, HMD/WD | SL24HD | 628 | SEL |
| (1) Office Lock | 93K7AB15D-S3 | 626 | BES |
| × / | 95K/AD15D-55 | 626 | BES |
| (1) Key Cylinder Core | 40.4037P P | | |
| (1) Closer, Regular Arm | 4040XP Reg | 689 | LCN |
| (1) Armor Plate | KA050-2 34 x 2LDW x CS x B4E | 630 | TRI |
| (1) Wall Stop/Holder | 1283-6S | 626 | TRI |
| Hardware Set 02 | | | |
| (3) Butt Hinge | AB800 x 4.5 x 4 | 630 | HAG |
| (1) Push Plate | 1809-4 x RC | 630 | TRI |
| (1) Pull Plate | 1014-3B x RC | 630 | TRI |
| (1) Toe Pull | 48 | 630 | DJO |
| × / | | 689 | |
| (1) Closer, Regular Arm | 4040XP Reg | | LCN |
| (1) Kick Plate | KO050 10 x 2LDW x CS x B4E | 630 | TRI |
| (1) Mop Plate | KM050 4 x 1LDW x CS x B4E | 630 | TRI |
| (1) Wall Stop, Convex | 1270CX | 626 | TRI |
| Note 1: Adjust closer's spring power | all the way down. | | |
| Hardware Set 03 | | | |
| (3) Butt Hinge | AB800 x 4.5 x 4 | 630 | HAG |
| ` / | 45H7T-15H-VIB | 626 | BES |
| | 43Π/1-13Π-VID | | |
| (1) Mortise Cylinder | 40.40X/D D | 626 | BES |
| (1) Closer, Regular Arm | 4040XP Reg | 689 | LCN |
| (1) Kick Plate | KO050 10 x 2LDW x CS x B4E | 630 | TRI |
| (1) Mop Plate | KM050 4 x 1LDW x CS x B4E | 630 | TRI |
| (1) Wall Stop, Convex | 1270CX | 626 | TRI |
| | | | |

| Hai | rdware Set 03A | | | |
|-----|---------------------------------|----------------------------|-------|-----|
| (3) | Butt Hinge | AB700 x 4.5 x 4.5 | 652 | HAG |
| (1) | Dormitory Lock w/Indicator | 45H7T-15H-VIB | 626 | BES |
| (1) | Mortise Cylinder | | 626 | BES |
| (1) | Closer, Regular Arm | 4040XP Reg | 689 | LCN |
| (1) | Kick Plate | KO050 10 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Wall Stop, Convex | 1270CX | 626 | TRI |
| Hai | rdware Set 04 | | | |
| (3) | Butt Hinge | AB750 x 5 x 4.5 | 652 | HAG |
| (1) | Fire Exit Device, Rim, 03 | FL-2103 x 4903A | 630 | PHI |
| (1) | Rim Cylinder | 12 2103 K 190311 | 626 | BES |
| (1) | Closer, w/Stop | 4040XP CUSH | 689 | LCN |
| (1) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Cat H Adhesive Jamb Seal Set | 2525B | Brown | NGP |
| () | Note: Apply to top jamb only. | | | |
| (1) | Cat H Jamb Seal Set | 135NA | 628 | NGP |
| () | Note: Apply to side jambs only. | | | |
| Наг | rdware Set 05 | | | |
| (3) | Butt Hinge | AB750 x 5 x 4.5 | 652 | HAG |
| (1) | Panic Device, Rim, 03 | 2103CD x 4903A | 630 | PHI |
| (1) | Rim Cylinder | 2100 02 11 15 0011 | 626 | BES |
| (1) | Mortise Thumbturn Cylinder | | 626 | BES |
| (1) | Closer, HD Parallel Arm | 4040XP EDA | 689 | LCN |
| (1) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Wall Stop/Holder | 1283-6S | 626 | TRI |
| Hai | rdware Set 06 | | | |
| (3) | Butt Hinge | AB700 x 4.5 x 4 | 652 | HAG |
| (1) | Storeroom Lock | 93K7D-S3 | 626 | BES |
| (1) | Key Cylinder Core | | 626 | BES |
| (1) | Closer, Regular Arm | 4040XP Reg | 689 | LCN |
| (1) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Universal Stop, 1-1/2" | 7280 | 630 | TRI |
| (1) | Cat H Jamb Seal Set | 135NA | 628 | NGP |
| Наг | rdware Set 06A | | | |
| (3) | Butt Hinge | AB750 x 5 x 4.5 | 652 | HAG |
| (1) | Storeroom Lock | 93K7D-S3 | 626 | BES |
| (1) | Key Cylinder Core | 75K7D 55 | 626 | BES |
| (1) | Closer, w/Stop | 4040XP Reg | 689 | LCN |
| (1) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Cat H Jamb Seal Set | 135NA | 628 | NGP |
| Ноз | rdware Set 07 | | | |
| (3) | Butt Hinge | AB700 x 4.5 x 4 | 652 | HAG |
| (1) | Classroom Deadbolt | 48H7R-S1 | 626 | BES |
| (1) | Mortise Cylinder | | 626 | BES |
| (1) | Wall Stop, Convex | 1270CX | 626 | TRI |

| Ha | rdware Set 08 | | | |
|-----|----------------------------|----------------------------|-----|-----|
| (3) | Butt Hinge | AB700 x 4.5 x 4.5 | 652 | HAG |
| (1) | Storeroom Lock | 93K7D-S3 | 626 | BES |
| (1) | Key Cylinder Core | | 626 | BES |
| (1) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Wall Stop, Convex | 1270CX | 626 | TRI |
| Но | rdware Set 08A | | | |
| (3) | Butt Hinge | AB700 x 4.5 x 4.5 | 652 | HAG |
| (1) | Storeroom Lock | 93K7D-S3 | 626 | BES |
| (1) | Key Cylinder Core | /3K/D-33 | 626 | BES |
| (1) | Kick Plate | KO050 16 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Wall Stop, Convex | 1270CX | 626 | TRI |
| (1) | wan stop, convex | 12/00/1 | 020 | TIG |
| Ha | rdware Set 09 | | | |
| (6) | Butt Hinge | AB750 x 5 x 4.5 | 652 | HAG |
| (1) | Manual Flush Bolt | 3917-12 | 626 | TRI |
| (1) | Manual Flush Bolt | 3917-24 (top) | 626 | TRI |
| (1) | Office Lock, 3/4" latch | 93K7AB15D-S3-3/4 | 626 | BES |
| (1) | Key Cylinder Core | | 626 | BES |
| (1) | Wall Stop, Convex | 1270CX | 626 | TRI |
| (1) | Overhead Stop, HD, Surface | 900S | 630 | GLY |
| Hai | rdware Set 10 | | | |
| (6) | Butt Hinge | AB750 x 5 x 4.5 | 652 | HAG |
| (1) | Panic Device, SVR, 01 | 2201CD x 4903A x LBR | 630 | PHI |
| (1) | Panic Device, SVR, 03 | 2203CD x 4902A x LBR | 630 | PHI |
| (1) | Rim Cylinder | | 626 | BES |
| (2) | Mortise Thumbturn Cylinder | | 626 | BES |
| (2) | Closer, HD Parallel Arm | 4040XP EDA | 689 | LCN |
| (2) | Kick Plate | KO050 8 x 1LDW x CS x B4E | 630 | TRI |
| (2) | Wall Stop/Holder | 1283-6S | 626 | TRI |
| TT | udavana Ca4 11 | | | |
| | rdware Set 11 | | (2) | DEC |
| (1) | Mortise Cylinder | 1 1: 1 : | 626 | BES |

Note 1: Balance of hardware, including locking device compatible with 7-pin SFIC key cylinder, by door supplier. Contractor to coordinate cylinder type and cam required.

Hardware Set 12

| (1) | Continuous Hinge, ALD | SL11HD | 628 | SEL |
|-----|-----------------------------------|---|-----|-----|
| (1) | Communicating Lock | 45H7G15H x LC | 626 | BES |
| (2) | Mortise Dummy Cylinder | | 626 | BES |
| (1) | Closer, HD Parallel Arm | 4040XP EDA x 4040-61 | 689 | LCN |
| | Note: Provide closer drop plate a | as required for top rail configuration. | | |
| (1) | Wall Stop, Convex | 1270CX | 626 | TRI |
| | | | | |

Note 1: ADA threshold, jamb and door bottom seals by door supplier.

Note 2: Retract deadbolt. Install dummy cylinders so that door cannot be locked on either side.

Note: Door-Set Index on follow page.

3.8 DOOR - HARDWARE SET INDEX

| - | |
|-----------------------|-----------------|
| Door | HW Set |
| 100.1 | 01A |
| 100.2 | 01A |
| 101 | 01 |
| 102 | 01 |
| 103.2 | 01B |
| 103A | 01 |
| 104 | R05A |
| 106 | 03A |
| 107.1 | 04 |
| 107.2 | R04 |
| 108 | 02 |
| 109 | 02 |
| 110.1 | 05 |
| 110.2 | 05 |
| 111 | 01B |
| 112 | 06 |
| 113B | R06 |
| 116 | R05 |
| 201 | 03 |
| 202.1 | 02 |
| 202.2 | 07 |
| 203 | 01A |
| 203.1 | 11 |
| 202.1 202.2 203 | 02 07 01A |

| 203.2 | 11 |
|--------|------|
| 203B | 01C |
| 203F | 01C |
| 203G | 01D |
| 204.1 | 12 |
| 204.2 | 12 |
| 204A | 08A |
| 204B | 09 |
| 205.1 | 08 |
| 206.1 | R07 |
| 206.2 | 07 |
| C200A | 10 |
| EB | 06A |
| L200A | R05 |
| L200B | R05 |
| L200C | 01E |
| ST1 | R03 |
| ST2 | R03A |
| V100.1 | E01 |
| V100.2 | E02 |
| V200.1 | R01 |
| V200.2 | R01 |
| V200.3 | R02 |
| V200.4 | R02A |

END OF SECTION

SECTION 087100.01 - FINISH HARDWARE SUPPLIER'S CERTIFICATION

FINISH HARDWARE SUPPLIER'S CERTIFICATION

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

| Date Submitted: | |
|---|--|
| Name & Address of Finish Hardware Supplier: | |
| | |
| | |
| I certify that | rtified by DHI as an Architectural Hardware led the educational experience requirements of |
| All hardware for this project shall be scheduled and fu person listed above, who is also a full-time employee of | |
| DHI Membership Number | |
| DHI Official Seal Valid Through | (Date) |
| Signed: Title: | |

SECTION 088000 - GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 079005 Joint Sealers: Sealant and back-up material.
- B. Section 081113 Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- C. Section 081416 Flush Wood Doors: Factory glazed doors.
- D. Section 084313 Aluminum-Framed Storefronts: Framing system.
- E. Section 088300 Mirrors.
- F. Section 102800 Toilet, Bath, and Laundry Accessories: Mirrors.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2014.
- C. ASTM C1036 Standard Specification for Flat Glass; 2011.
- D. ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- E. ASTM C1193 Standard Guide for Use of Joint Sealants; 2013.
- F. ASTM E2190 Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- G. GANA (GM) GANA Glazing Manual; 2009.
- H. GANA (SM) GANA Sealant Manual; 2008.

1.04 SUBMITTALS

- A. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- B. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C. Product Data on Solar Control Coatings: Provide product data on all specified solar control coatings to be provided.

1.05 OUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- C. Insulated Glass Fabricator Qualifications: Current, approved member of the Insulating Glass Certification Council (IGCC). Member warrants that its manufactured insulated glass units (IGU) will correspond in all material respects to the specification and will be free from defects in material and workmanship for ten (10) years from the date of substantial completion.

1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

A. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 GLASS MATERIALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following;
- B. Glass Manufacturers:
 - 1. Cardinal Glass Industries: www.cardinalcorp.com.
 - 2. AGC Flat Glass North America, Inc: www.na.agc-flatglass.com.
 - 3. Guardian Industries Corp: www.sunguardglass.com.
 - 4. Pilkington North America Inc: www.pilkington.com/na.
 - 5. Vitro Glass + PPG Glass: www.ppgideascapes.com.
 - 6. Trulite Glass and Aluminum Solutions: www.trulite.com
 - 7. Zeledyne: www.versaluxglass.com.
- C. Float Glass: Provide float glass based glazing unless noted otherwise.
 - 1. Annealed Type: ASTM C1036, Type I Transparent Flat, Class 1 Clear, Quality-Q3.
 - 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
 - 3. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.
- D. Clear Float Glass: Clear, annealed.
 - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
 - 2. Comply with ASTM C 1048.
- E. Safety Glass: Clear; fully tempered.
 - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
 - 2. Comply with 16 CFR 1201 test requirements for Category II.
 - 3. 6 mm minimum thick.
 - 4. Provide this type of glazing in the locations indicated on the drawings.

2.02 SEALED INSULATING GLASS UNITS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cardinal Glass Industries: www.cardinalcorp.com.
 - 2. Glenny Glass: www.glennygls.com
 - 3. Guardian Industries Corp: www.guardian.com.
 - 4. Louisville Plate Glass: www.louisvilleplateglass.com
 - 5. Oldcastle Building Envelope: www.oldcastlebe.com
 - 6. Trulite Glass and Aluminum Solutions: www.trulite.com
 - 7. Viracon, Apogee Enterprises, Inc: www.viracon.com.
- B. Sealed Insulating Glass Units: Types as indicated.

- 1. Application: Exterior, except as otherwise indicated.
- 2. Durability: Certified by an independent testing agency to comply with ASTM E2190.
- 3. Edge Spacers: Aluminum, bent and soldered corners.
- 4. Edge Seal: Glass to elastomer with supplementary silicone sealant.
- 5. Purge interpane space with dry hermetic air.
- C. Insulated Glass Units: Double pane with glass to elastomer edge seal.
 - 1. Locations: Exterior metal windows, storefront and/or curtainwall window systems.
 - 2. Total unit thickness of 1 inch, minimum.
 - 3. Outer pane of 1/4" glass, inner pane of 1/4" glass.
 - 4. Place low E coating on No.2 surface within the unit.
 - 5. Low-E Coating: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 - a. AGC Energy Select 40
 - b. Guardian SN-68
 - c. Vitro+PPG Solarban 60
- D. Insulated Glass Units: Double pane with glass to elastomer edge seal.
 - 1. Locations: Exterior hollow metal, aluminum storefront and /or curtainwall doors.
 - 2. Total unit thickness of 7/8 inch, minimum.
 - 3. Outer pane of 3/16 glass, inner pane of 3/16 glass.
 - 4. Place low E coating on No.2 surface within the unit.
 - 5. Low-E Coating: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 - a. AGC Energy Select 40
 - b. Guardian SN-68
 - c. Vitro+PPG Solarban 60

2.03 GLAZING COMPOUNDS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include,
- B. Manufacturers:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 5. Substitutions: Refer to Section 016000 Product Requirements.
- C. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; manufacturers standard color.

2.04 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.

1. Manufacturers:

- a. Pecora Corporation: www.pecora.com.
- b. Tremco Global Sealants: www.tremcosealants.com.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; manufacturers standard color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- E. Install sealants in accordance with manufacturer's instructions.

3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.04 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
- C. Fill gaps between glazing and stops with sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.05 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

3.06 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

END OF SECTION 088000

| 421 of 1482 FINISH LEGEND | | | | | | |
|---------------------------|----------|----------------------------|-----------------------------------|----------|---|--|
| Jan 202 | 2 | ECTC STUDENT | | | RTA #2020 | |
| JUITZUZZ | | ECIC SIDDLINI | CLIVIER | | K17A #2020 | |
| SPEC SECTION | KEY | FINISH | | | DESCRIPTION | |
| | ETR | EXISTING TO REMAIN | | | ETR | |
| | | Endin to the transfer | | | | |
| | EXP | EXPOSED TO STRUCTURE ABOVE | | | | |
| 03 3000 | SC1 | SEALED CONCRETE | MFR.: | - | REFER TO 033000 CAST IN PLACE CONCRETE | |
| | | | PRODUCT: | | REFER TO 033000 CAST IN PLACE CONCRETE | |
| | | | LOCATION: | | GENERAL | |
| | | | NOTE: | | PROVIDE APPROPRIATE TRANSITION AT DOOR THRESHOLD USDA APPROVED SEALER | |
| | | | | | OSBATA I NO YED SEALEN | |
| 06 4100 | HPL3 | HIGH PRESSURE LAMINATE | MFR.: | | WILSONART | |
| | | VANITY ENCLOSURE PANELS | COLOR: NO: | _ | CASUAL LINEN 4944-38 | |
| | | | FINISH: | | FINE VELVET | |
| | | | LOCATION: | | RESTROOM ENCLOSURE PANELS AT VANITIES & BASE CABINET IN | |
| | | | | | MOTHER'S ROOM | |
| | HPL4 | HIGH PRESSURE LAMINATE | MFR.: | | FORMICA | |
| | | | COLOR: | _ | EARTHEN TWILL (GRAIN WILL RUN HORIZONTALLY) | |
| | | | NO: | _ | 8828-58 | |
| | | + | FINISH: LOCATION: | | MATTE VERTICAL FRONTS OF SERVING LINE, BELOW COUNTER ON THE STUDENT | |
| | | | LOCATION. | | SIDE | |
| | | | | | | |
| | SSC1 | STAINLESS STEEL CABINETS | MFR.: | - | TBD | |
| | | OPEN SHELVING UNITS | COLOR: GAUGE: | _ | STAINLESS STEEL 18 GA | |
| | | | FINISH: | | No.4 SATIN FINISH | |
| | | | LOCATION: | | OPEN SHELVING UNITS ON SERVING SIDE OF SERVING LINE | |
| | SS1 | SOLID-SURFACE | MFR.: | | HI-MACS | |
| | 331 | RESTROOM COUNTER TOP | COLOR: | | MOON HAZE | |
| | | | THICKNESS: | | 1/2" | |
| | | | EDGE PROFILE: LOCATION: | _ | EASED RESTROOMS/SERVING LINE/SILLS | |
| | | | LOCATION. | | RESTROOMS/SERVING LINE/SILES | |
| | | | | | | |
| 08 1416 | WD1 | WOOD VENEER FACE DOOR | VENEER SUPPLIER: WOOD SPECIES: | | TBD TBD | |
| | | BOOK | HPVA GRADE: | | AA | |
| | | | FINISH: | | TBD | |
| | | | COLOR: SIDE MATCH: | | TBD SLIP | |
| | | | ACCESSORIES: | - | PROVIDE ONE COAT HOOK (SAGATSUNE DSH-01 STAINLESS STEEL) ON | |
| | | | | | EACH DOOR AT 5'-0" A.F.F. | |
| | | | LOCATION: | | TYPICAL | |
| | | + | NOTE: | - | | |
| 09 2116 | FRP1 | FIBERGLASS REINFORCED | MFR.: | | CRANE COMPOSITES | |
| | | PANELS | PRODUCT: | | STANDARD FRP | |
| | | + | FINISH: COLOR: | | SMOOTH/FSI WHITE (85) | |
| | | | LOCATION: | | CUSTODIAL AT MOP SINK & UNDER COUNTER ON SERVICES SIDE OF | |
| | | | | | FOOD SERVICE COUNTERS | |
| 09 3000 | CTI | CERAMIC OR PORCELAIN TILE | MFR.: | \vdash | FLORIDA TILE | |
| 07 3000 | CII | FLOOR TILE & 4" WALL BASE | STYLE: | _ | TIDES | |
| | | | COLOR: | | SAND CASTLE | |
| | | | SIZE: GROUT: | | 12"X24" TEC POWERGROUT | |
| | | + | GROUT COLOR: | | TBD | |
| | | | INSTALLATION: | | STACK BOND | |
| | | | ACCESSORIES: | 1 | PROVIDE SCHLUTER-JOLLY BRUSHED STAINLESS STEEL ON ALL OUTSIDE | |
| | | | LOCATION: | \vdash | CORNERS & ON TOP OF THE CUT WALL BASE FLOOR TILE IN RESTROOMS | |
| | | | LOCATION. | T | LES ON THE IT NEW TOO THO | |
| | QT1 | UNGLAZED QUARRY TILE | MFR.: | _ | AMERICAN OLEAN | |
| | - | FLOOR TILE & BASE | STYLE: COLOR: | - | QUARRY NATURALS SHADOW GRAY | |
| | | + | SIZE: | _ | 8"X8" TILE | |
| | | | | | 5"X8" BASE | |
| | | | GROUT COLOR: | | TEC POWERGROUT | |
| <u></u> | <u> </u> | | GROUT COLOR: | 1 | TBD | |

| | | Tenana | 422 of 1482 | D TO COLUMN ON I |
|--------------|----------|------------------------------------|------------------|---|
| SPEC SECTION | KEY | FINISH | | DESCRIPTION |
| | | | installation: | MONOLITHIC |
| | | | LOCATION: | COOLER/FREEZER FLOOR |
| 09 4000 | TR1 | TEDD 4770 /EVICTING | MED. | STRIP AND RE-POLISH EXISTING TERRAZZO FLOOR (AND BASE IN SOME |
| 09 4000 | IKI | TERRAZZO (EXISTING CEMENTUTOUS) | MFR.: | AREAS) |
| | | CEMENIOTO03) | EPOXY: | TO MATCH EXISTING |
| | | | CHIP FORMULA: | TO MATCH EXISTING |
| | | | LOCATION: | TYPICAL FIELD TILE; REFER TO ROOM FINISH SCHEDULE |
| | | | | , |
| | TR2 | TERRAZZO (EPOXY) | MFR.: | PATCH AND POLISH NEW TERRAZZO FLOOR TO MATCH EXISTING (AND |
| | | | | NEW INTEGRAL COVE BASE IN SOME AREAS) |
| | | | EPOXY: | TO MATCH EXISTING |
| | | | CHIP FORMULA: | TO MATCH EXISTING |
| | | | NOTE: | ALL CRACKS/AREAS OF MISSING TERRAZO/DIVOTS/ETC IN EXISTING |
| | | | | TERRAZZO WILL BE PATCHED AND REPAIRED WITH COLOR MATCHING |
| | | | | MATRIX AND A CHIP FORMULA TO MATCH EXISTING. ALL CRACKS TOO |
| | | | | SMALL TO HAVE A CHIP MIXTURE WILL RECEIVE COLOR MATCHING |
| | - | | | EPOXY. |
| | | | LOCATION: | TYPICAL FIELD TILE; REFER TO ROOM FINISH SCHEDULE |
| 09 5113 | ADC1 | ACCULTICAL DANIEL CELLING | AAED . | ARMSTRONG |
| 09 3113 | APC1 | ACOUSTICAL PANEL CEILING TYPICAL | MFR.: STYLE: | FINE FISSURED |
| | | ITFICAL | NO.: | 1713 |
| | | | SIZE: | 2'x2' |
| | | | COLOR: | WHITE |
| | | | EDGE: | SQUARE |
| | | | EDGE: | 4"H AXIOM AT ALL APC LEVEL CHANGES IN STUDENT LOUNGE |
| | | | GRID: | 15/16" |
| | | | LOCATION: | TYPICAL |
| | | | NOTE: | ALL CUT TILE EDGES TO BE PAINTED TO MATCH FACE OF TILE |
| | | | | |
| | APC2 | ACOUSTICAL PANEL CEILING | MFR.: | ARMSTRONG |
| | | CLOUDS | STYLE: | KITCHEN ZONE (WASHABLE) |
| | | | NO.: | 673 |
| | | | SIZE: | 2'x2' |
| | | | COLOR: | WHITE |
| | | | EDGE: | SQUARE |
| | | | GRID: | 15/16" |
| | | | LOCATION: | REFER TO A2.1 & A2.2 ROOM FINISH SCHEDULES |
| | | | NOTE: | ALL CUT TILE EDGES TO BE PAINTED TO MATCH FACE OF TILE |
| 09 6500 | SVT1 | RESILIENT TILE FLOORING: | MFR.: | TARKETT |
| 07 8300 | 3 4 1 1 | SOLID VINYL TILE | STYLE: | CORTINA GRANDE |
| | | SOCID VIIVE HEE | COLOR: | 509 CAMPY |
| | | | SIZE: | 16"x16" |
| | | | TOTAL THICKNESS: | 0.125" (3.18MM) |
| | | | INSTALLATION: | GLUE DOWN, ONE DIRECTION |
| | | | LOCATION: | REFER TO ROOM FINISH SCHEDULES ON A2.1 & A2.2 |
| | | | | |
| | SDT1 | RESILIENT TILE FLOORING: | MFR.: | ARMSTRONG |
| | | STATIC DISIPATIVE TILE | STYLE: | STATIC DISSAPATIVE TILE |
| | _ | | COLOR: | 51953 PEARL WHITE |
| | 1 | | SIZE: | 12"X12" |
| | 1 | | INSTALLATION: | GLUE DOWN, ONE DIRECTION |
| | - | | LOCATION: | IT CLOSET |
| 00.4500 | LV/T1 | DECILIENT THE FLOODING: | 1,150 | CLIANA |
| 09 6502 | LVT1 | RESILIENT TILE FLOORING: | MFR.: STYLE: | SHAW TEDDAIN II |
| | 1 | LUXURY VINYL TILE | STYLE NUMBER: | TERRAIN II 0454V |
| | + | | COLOR: | ASH |
| | 1 | | WEAR LAYER: | 20 MIL |
| | 1 | + | SIZE: | 6" X 48" |
| | 1 | | THICKNESS: | 0.5MM |
| | 1 | | FINISH: | EXOGUARD |
| | İ | | RECOMMENDED | SHAW 4100 OR S150 |
| | | | ADHESIVE: | |
| | | | installation: | STAGGER |
| | | | LOCATION: | CORRIDORS/ELEVATOR |
| | | | | |
| 09 6513 | RB1 | RESILIENT BASE & ACCESSORIES | MFR.: | TARKETT |
| | | RUBBER WALL BASE | STYLE: | COVE (ROLLS) |
| | | | COLOR: | MOONROCK 29 |
| | 1 | | HEIGHT: | 4" |
| ļ | | | LOCATION: | REFER TO FINISH SCHEDULE |
| 00.4010 | CDT: | CARRETTHE | =- | CHAM |
| 09 6813 | CPT1 | CARPET TILE | MFR.: | SHAW |
| <u>I</u> | 1 | TRACK OFF | COLLECTION: | ALL ACCESS |

| | | | 423 of 1482 | | |
|--------------|---------|--------------------------------------|---|---------|---|
| SPEC SECTION | KEY | FINISH | | | DESCRIPTION |
| | | | STYLE: | | PACE TILE |
| | | | STYLE NUMBER: | | 5T413 |
| | | | COLOR: | | TBD |
| | | | SIZE: | | 24"X24" |
| | | | FIBER: | | ECO SOLUTION Q NYLON |
| | | | DYE METHOD: | | 100% SOLUTION DYED |
| | | | PRIMARY BACKING: | | SYNTHETIC |
| | | | SECONDARY BACKING: | | ECOWORX TILE |
| | - | | | | |
| | | | PROTECTIVE TREATMENTS: | | SSP SHAW SOIL PROTECTION |
| | | | TUFTED WEIGHT: | - | 28 oz/yd² |
| | | | INSTALLATION: | | MONOLITHIC |
| | | | LOCATION: | | IN EXISTING RECESSES IN VESTIBULE V200 & STAIR ST, FIELD VERIFY RECESS |
| | | | | | SIZES |
| | | | | | |
| 09 7800 | STST1 | STAINLESS STEEL WALL PANELS | MFR.: | | TBD |
| | | | PRODUCT: | | STAINLESS STEEL WALL PANELS AND TRIM |
| | | | HEIGHT: | _ | FULL HEIGHT, 4X10 SHEETS CUT TO FIT |
| | | | GAUGE: | | 18 GA |
| | | | | | |
| | - | <u> </u> | FINISH: | | No.4 SATIN FINISH |
| | | | STST TRIMS: | | OUTSIDE CORNERS |
| | | | | | TOP CAPS |
| | 1 | | | | DIVIDER TRIMS |
| | <u></u> | | | | INSIDE CORNERS |
| | | | | 5 | ETC FOR A COMPLETE INSTALL |
| | | | LOCATION: | Ť | KITCHEN BOH, REFER TO PLANS |
| | | | 200, | | INTOTILITY DOTTY NEL EN TO TE WIL |
| 09 9000 | P1 | PAINTING | MFR.: | | TBD |
| 07 7000 | 11 | TYPICAL WALL PAINT | COLOR: | H | TBD |
| | - | ITPICAL WALL PAINI | | | |
| | | | SHEEN: | | FLAT AT CEILINGS |
| | | | | 2 | EGGSHELL AT WALLS |
| | | | LOCATION: | | SEE FINISH SCHEDULES TYPICAL CORRIDORS |
| | | | | | |
| | P2 | PAINTING | MFR.: | | TBD |
| | | TYP. WALL PAINT | COLOR: | | TBD |
| | | | | | FLAT AT CEILINGS |
| | | | OTTEET (. | | EGGSHELL AT WALLS |
| | + | | LOCATION | | SEE FINISH SCHEDULES. TYPICAL OFFICES/CLASSROOMS |
| | | | LOCATION: | _ | SEE FINISH SCHEDULES, ITPICAL OFFICES/CLASSROOMS |
| | | | | | |
| | P3 | PAINTING | MFR.: | | TBD |
| | | ACCENT PAINT | COLOR: | | TBD |
| | | | SHEEN: | 1 | FLAT AT CEILINGS |
| | | | | 2 | EGGSHELL AT WALLS |
| | | | LOCATION: | | SEE FINISH SCHEDULES |
| | | | | | |
| | P4 | PAINTING | MFR.: | | TBD |
| | 1 4 | CEILING PAINT | COLOR: | | TBD |
| | | CEILING FAINI | | | |
| | | | | _ | FLAT AT CEILINGS |
| | | | LOCATION: | | REFER TO ROOM FINISH SCHEDULES |
| | | | | | |
| | P5 | PAINTING | MFR.: | L | TBD |
| | <u></u> | HOLLOW METAL FRAMES | COLOR: | L | TBD |
| | | | SHEEN: | | SEMIGLOSS AT HOLLOW METAL DOOR FRAMES |
| | | | LOCATION: | | HOLLOW METAL DOOR FRAMES, TYPICAL |
| | 1 | | 25 57 51 % | Т | |
| | P6 | PAINTING | MFR.: | H | TBD |
| | 1 0 | ACCENT PAINT | COLOR: | H | TBD |
| | + | ACCLINI I AINI | | | |
| | + | + | SHEEN: | - | FLAT AT CEILINGS |
| | 1 | | 1 | _2 | EGGSHELL AT WALLS |
| | 1 | | LOCATION: | | 2 STORY ACCENT WALLS ADJACENT TO ELEVATOR |
| | | | | | |
| | P7 | PAINTING | MFR.: | | TBD |
| | | CHALKBOARD PAINT | COLOR: | | TBD |
| | 1 | | SHEEN: | 1 | FLAT AT CEILINGS |
| | | † | 5EI 1. | | EGGSHELL AT WALLS |
| | | | | ⊢ | 2 STORY ACCENT WALLS ADJACENT TO ELEVATOR |
| | | | LOCATION | | TE STEAM FOR CHILL MADE AND |
| | | | LOCATION: | | |
| 10 1101 | 1457 | WIGHT DISCHARGE AND A 1222 | | | |
| 10 1101 | MB6 | VISUAL DISPLAY BOARDS | MFR.: | | CLARIDGE |
| 10 1101 | MB6 | VISUAL DISPLAY BOARDS MARKERBOARD | MFR.: STYLE: | | CLARIDGE CONCEPT DRY ERASE MARKERBOARD |
| 10 1101 | MB6 | • | MFR.: | | CLARIDGE |
| 10 1101 | MB6 | • | MFR.: STYLE: | | CLARIDGE CONCEPT DRY ERASE MARKERBOARD |
| 10 1101 | MB6 | • | MFR.: STYLE: SURFACE: | | CLARIDGE CONCEPT DRY ERASE MARKERBOARD LCS3 PORCELAIN WITH SLEEK NARROW TRIM |
| 10 1101 | MB6 | • | MFR.: STYLE: SURFACE: COLOR: SIZE: | | CLARIDGE CONCEPT DRY ERASE MARKERBOARD LCS3 PORCELAIN WITH SLEEK NARROW TRIM WHITE 4'-0" x 6'-0" |
| 10 1101 | MB6 | • | MFR.: STYLE: SURFACE: COLOR: SIZE: ACCESSORIES PER | | CLARIDGE CONCEPT DRY ERASE MARKERBOARD LCS3 PORCELAIN WITH SLEEK NARROW TRIM WHITE |
| 10 1101 | MB6 | • | MFR.: STYLE: SURFACE: COLOR: SIZE: | 1 | CLARIDGE CONCEPT DRY ERASE MARKERBOARD LCS3 PORCELAIN WITH SLEEK NARROW TRIM WHITE 4'-0" x 6'-0" RARE EARTH MAGNETS |
| 10 1101 | MB6 | • | MFR.: STYLE: SURFACE: COLOR: SIZE: ACCESSORIES PER | 1 | CLARIDGE CONCEPT DRY ERASE MARKERBOARD LCS3 PORCELAIN WITH SLEEK NARROW TRIM WHITE 4'-0" x 6'-0" RARE EARTH MAGNETS MAGNETIC SLIM MARKER CADDY |
| 10 1101 | MB6 | • | MFR.: STYLE: SURFACE: COLOR: SIZE: ACCESSORIES PER | 1 2 3 | CLARIDGE CONCEPT DRY ERASE MARKERBOARD LCS3 PORCELAIN WITH SLEEK NARROW TRIM WHITE 4'-0" x 6'-0" RARE EARTH MAGNETS MAGNETIC SLIM MARKER CADDY MAGNETIC ERASER |
| 10 1101 | MB6 | • | MFR.: STYLE: SURFACE: COLOR: SIZE: ACCESSORIES PER | 1 2 3 4 | CLARIDGE CONCEPT DRY ERASE MARKERBOARD LCS3 PORCELAIN WITH SLEEK NARROW TRIM WHITE 4'-0" x 6'-0" RARE EARTH MAGNETS MAGNETIC SLIM MARKER CADDY |

| CREO CECTION | I/FV | FINISH | 424 of 1482 | | DECORPTION |
|--------------|--|---------------------------|-------------------|----------|---|
| SPEC SECTION | KEY | FINISH | 1001701 | | DESCRIPTION |
| | | _ | LOCATION: | | REFER TO FLOOR PLANS ON A2.1 |
| 10 1424 | 1 | SIGN TYPE 1 | MFR: | | APPENX ARCHITECTURAL SIGNAGE |
| 10 1424 | 1 | ROOM SIGNAGE | BACKGROUND COLOR: | _ | U-ULTRA LIGHT-GREY FROSTED |
| | | ROOM SICINACE | COPY COLOR: | _ | BU BLACK UMBER |
| | | | LOGO: | | YES YES |
| | | | BRAILLE: | _ | YES |
| | | | SIZE: | | 8" x 8" |
| | | | HARDWARE: | | STST STAND-OFFS |
| | | | THE WEST THE | | 1/2" DIAMETER |
| | | | | | 3/4" TALL BARRELS |
| | | | | | 3/16" TALL CAP |
| | | | NOTE: | _ | REFER TO "SIGNAGE TYPES" ON A2.3 |
| | | | LOCATION: | | REFER TO ROOM FINISH SCHEDULES |
| | | | | | |
| | | SIGN TYPE 2 | MFR: | | APPENX ARCHITECTURAL SIGNAGE |
| | | ROOM SIGNAGE | BACKGROUND COLOR: | | U-ULTRA LIGHT-GREY FROSTED |
| | | | COPY COLOR: | | BU BLACK UMBER |
| | | | BRAILLE: | | YES |
| | | | SIZE: | | 8" x 8" |
| | | | GRAPHIC: | | APPROPRIATE, ELEVATOR, ADA RESTROOM, STAIR SYMBOLS |
| | | | HARDWARE: | | STST STAND-OFFS |
| | | | | | 1/2" DIAMETER |
| | | | | _ | 3/4" TALL BARRELS |
| | | | | 4 | 3/16" TALL CAP |
| | | | NOTE: | | REFER TO "SIGNAGE TYPES" ON A2.3 |
| | | | LOCATION: | Ĺ | REFER TO ROOM FINISH SCHEDULES |
| | | | | Ĺ | |
| | | SIGN TYPE 3 | MFR: | | APPENX ARCHITECTURAL SIGNAGE |
| | | DIRECTIONAL SIGNAGE | BACKGROUND COLOR: | | U-ULTRA LIGHT-GREY FROSTED |
| | | | COPY COLOR: | | BU BLACK UMBER |
| | | | BRAILLE: | | YES |
| | | | SIZE: | | 8"w x 4"h |
| | | | FEATURE: | | WILL INCLUDE "EXIT" SIGNS |
| | | | HARDWARE: | | STST STAND-OFFS |
| | | | | _ | 1/2" DIAMETER |
| | | | | | 3/4" TALL BARRELS |
| | | | | _ | 3/16" TALL CAP |
| | | | LOCATION: | | REFER TO ROOM FINISH SCHEDULES |
| | | | | | |
| | | SIGN TYPE 4 | MFR: | _ | APPENX ARCHITECTURAL SIGNAGE |
| | | DIRECTIONAL SIGNAGE | BACKGROUND COLOR: | _ | U-ULTRA LIGHT-GREY FROSTED |
| | | | COPY COLOR: | _ | BU BLACK UMBER |
| | | | LOGO: | _ | YES |
| | | | SIZE: | _ | 18'W x 20"h |
| | 1 | | FEATURE: | | LETTERS, NUMBERS & ARROWS |
| | | | HARDWARE: | | STST STAND-OFFS |
| | | | | _ | 1/2" DIAMETER |
| | | | | _ | 3/4" TALL BARRELS |
| | | | NOTE: | _ | 3/16" TALL CAP EXAMPLE ON A2.3, COPY TO BE DETERMINED AT A LATER DATE AND WILL |
| | | | NOTE: | | |
| | 1 | | LOCATION: | \vdash | VARY FROM SIGN TO SIGN REFER TO ROOM FINISH SCHEDULES |
| | 1 | | LUCAIION: | \vdash | KELEK IO KOOM LINISH 20HEDOTE2 |
| | 1 | SIGNITYPE 5 | MFR: | | APPENY APCHITECTURAL SIGNACE |
| | 1 | SIGN TYPE 5 EXIT STAIR | BACKGROUND COLOR: | \vdash | APPENX ARCHITECTURAL SIGNAGE U-ULTRA LIGHT-GREY FROSTED |
| | 1 | LAII SIMIK | COPY COLOR: | _ | BU BLACK UMBER |
| | 1 | - | BRAILLE: | | YES YES |
| | 1 | 1 | SIZE: | _ | 8'w X 8"h |
| | | | GRAPHIC: | | APPROPRIATE STAIR SYMBOLS |
| | 1 | | FEATURE: | _ | WILL INCLUDE "EXIT STAIR DOWN" |
| | 1 | - | HARDWARE: | _ | STST STAND-OFFS |
| | | | HANDWARE. | _ | 1/2" DIAMETER |
| | | | | _ | 3/4" TALL BARRELS |
| | 1 | | + | | 3/16" TALL CAP |
| | 1 | | LOCATION: | _ | REFER TO ROOM FINISH SCHEDULES |
| | | | 200711014. | | |
| | | LASER CUT ACRYLIC LETTERS | MFR: | | GEMINI LETTERS |
| | | _ SER SOLVIORIES ELITERS | ACRYLIC COLOR: | _ | TBD |
| | | | COPY: | _ | "ALTEC PATIO" WITH COMPANY LOGO |
| | 1 | | 3311. | | "MAGNOLIA BANK" WITH COMPANY LOGO |
| | | | | | "ROBBINS UNIVERSITY CENTER" |
| | 1 | | SIZE: | _ | 6"H |
| | 1 | | THICKNESS: | _ | 1/2" |
| | | | FONT: | _ | TBD FROM GEMINI STANDARDS |
| | 1 | | MOUNT: | _ | DOUBLE STICK TAPE |
| | 1 | | LOCATION: | _ | TBD |
| | 1 | ı | 200, 11011. | | <u>'</u> |

| | | Ten man | 425 of 1482 | | D TO COURT OU |
|--------------|----------|---------------------------|------------------------------|---|--|
| SPEC SECTION | KEY | FINISH | | | DESCRIPTION |
| | | VINIVI WINDOW FILM | A LED | | 214 |
| | | VINYL WINDOW FILM | MFR.: COLOR: | | ISM FROSTED |
| | | | LOCATION: | _ | CORRIDOR C100B |
| | | | NOTE: | | REFER TO F/A2.1 |
| | DRW | DONOR RECOGNITION WALL | | | |
| | | | | | |
| | DRW | COVER TO DIGITAL SCREEN | MFR: | | FAST SIGNS |
| | | | MATERIAL: | | PLEXI |
| | | | THICKNESS: BACKGROUND COLOR: | | 1/4" BACK PRINTED COLOR GRAPHIC - CLEAR SPACE FOR OWNER |
| | | | BACKGROUND COLOR. | | PROVIDED SCREEN BEHIND COVER |
| | | | SIZE: | | REFER TO SHEET AD2.1 |
| | | | GRAPHIC: | | TBD |
| | | | HARDWARE: | | 1" DIA STAINLESS STEEL, TAMPER RESISTANT STAND-OFFS - WITH A 1" |
| | | | | | PROJECTION FROM WALL SURFACE |
| | | | LOCATION: | | LOBBY - L100, SHEET A2.4 |
| | DDW | LIGDIZONTAL ACDVILC BADS | LAED: | | FACT CIONIC |
| | DRW | HORIZONTAL ACRYLIC BARS | MFR: MATERIAL: | | FAST SIGNS PLEXI |
| | | | SIZE: | | 1/4" THICK X REFER TO ELEVATIONS ON AD2.1 |
| | | | COLOR: | | TBD FROM MANUF, STANDARD THICK PIGMENTED AND THICK PAINTED |
| | | | | | COLORS |
| | | | MOUNTING: | | DIRECT TO WALL SURFACE |
| | | | LOCATION: | | LOBBY - L100, SHEET A2.4 |
| | <u> </u> | | | | |
| | DRW | ACRYLIC LASER CUT LETTERS | MFR: | | FAST SIGNS |
| | 1 | | MATERIAL: SIZES/FONTS: | - | ACRYLIC REFER TO SHEET AD2.1 |
| | | | SIZES/FOINIS. | 1 | 1-1/2"H X 1/4"THICK; RETAIN REGIONAL TALENT |
| | | | | | 1-1/2"H X 1/4"THICK: KETAIN REGIONAL TALEIN 1-1/2"H X 1/4"THICK: EXPAND ACCESS TO EDUCATION |
| | | | | | 1-1/2"H X 1/4"THICK: DEVELOP A WORLD-CLASS WORKFORCE |
| | | | | | 2"H X 1/4"THICK: OWNER'S QUOTE TBD |
| | | | | | 6"H X 1/2" THICK: Thank You |
| | | | | 7 | 6"H X 1/2" THICK: DINING / COMMONS (DIRECTIONAL ARROW SYMBOL) |
| | | | COLOR: | | TBD FROM MANUF. STANDARD THICK PIGMENTED AND THICK PAINTED |
| | | | | | COLORS |
| | | | SIZE: | | REFER TO SHEET AD2.1 |
| | | | MOUNTING: | | FLUSH TO WALL SURFACE OR ACRYLIC PANEL, REFER TO ELEVATIONS ON |
| | | | LOCATION | | AD2.1 |
| | | | LOCATION: | | LOBBY L100 & LOBBY L200, SHEET A2.4 |
| | DRW | GRAPHIC PRINTED PLAQUES | MFR: | | FAST SIGNS |
| | DRTT | OKA THE TRIVIED FEAGUES | MATERIAL: | | PLEXI |
| | | | THICKNESS: | | 1/4" |
| | | | BACKGROUND COLOR: | | BACK PRINTED COLOR GRAPHIC - OWNER PROVIDED IMAGES |
| | | | SIZE: | | 2'-10"W X 1'-4"H |
| | | | GRAPHIC: | | TBD; BACKPRINTED ON PANEL |
| | | | HARDWARE: | | 1" DIA STAINLESS STEEL, TAMPER RESISTANT STAND-OFFS - WITH A 1" |
| | | | LOCATION: | | PROJECTION FROM WALL SURFACE LOBBY - L100, SHEET A2.4 |
| | | | LOCATION. | | LOBBT - LTOO, SHEET AZ.4 |
| 10 1550 | TC1 | TOILET COMPARTMENTS | MFR.: | | SCRANTON |
| | 1 | AND URINAL SCREENS | STYLE: | | FLOOR ANCHORED / OVERHEAD BRACED |
| | | | COLOR: | | NICKEL |
| | _ | | TEXTURE: | | HAMMERED |
| | 1 | 1 | ANCHORING: | | FLOOR ANCHORED / OVERHEAD BRACED |
| | 1 | _ | LOCATION: | | TYP GANGED RESTROOMS |
| 10 2600 | CG1 | WALL & CORNED CHARDS | MFR.: | | INPRO |
| 10 2000 | CG1 | WALL & CORNER GUARDS | PRODUCT: | | 160BN BLUNOSE SURFACE MOUNT CORNER GUARD |
| | | | HEIGHT: | | 8' (2.44m) |
| | 1 | | VINYL COVER: | | .080" (2MM) |
| | | | VINYL RETAINER: | | .070 (1.8MM) |
| | | | COLOR: | | STANDARD SOLID COLORS - TBD |
| | 1 | 1 | INSTALLATION: | | MECHANICALLY FASTENED VINYL RETAINER |
| | 1 | | ACCESSORIES: | _ | TOP/BOTTOM CAPS |
| | - | | NOTE: LOCATION/QTY: | | CUT TO SIZE IN FIELD AS NEEDED REFER TO PLANS |
| | + | + | LOCATION/QIT: | | INCLER TO LEARN |
| 10 5050 | ML1 | METAL LOCKERS | MFR.: | | LYON |
| | L | | TYPE: | | DOUBLE TIER |
| | | | COLOR: | | TBD |
| | | | SIZE: | | 12"W X 12"D X 72"H |
| | 1 | 1 | GAUGE (DOOR & FRAME): | | 16 |
| | 1 | | GAUGE (BODY): | | 24 |
| <u> </u> | | | LOCATION: | | CORRIDOR C200B (KITCHEN B.O.H.) |

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|--------------|---------|------------------------|-----------------------|----|--|--|
| SPEC SECTION | KEY | FINISH | | | DESCRIPTION | |
| | | | ACCESSORIES PER UNIT: | 1 | SLOPED TOP | |
| | | | | 2 | FINISHED END PANELS | |
| | | | | 3 | NUMBER PLATE | |
| | | | | 4 | ONE LOCKER SHALL MEET ADA REQUIREMENTS | |
| | | | | 5 | RECESSED LIFT HANDLE | |
| | | | | 6 | SHELF (X1) | |
| | | | | 7 | DOUBLE PRONG HOOK (X1) | |
| | | | | 8 | SINGLE PRONG HOOK (X3) | |
| | | | | 9 | STANDARD VENTILATION LOUVERS | |
| | | | | 10 | RUBBER BUMPERS AT DOOR | |
| | | | | 11 | 6" LEGS | |
| | | | NOTE: | | OWNER PROVIDED LOCKS | |
| | | | | | | |
| 12 2413 | RWS1 | MANUAL WINDOW SHADES | MFR.: | | DRAPER | |
| | | ROLLER WINDOW SHADES | STYLE: | | CLUTCH-OPERATED FLEXSHADE NEXD | |
| | | | SHADE FABRIC: | | PHIFER SHEERWEAVE INFINITY | |
| | | | OPENNESS FACTOR: | | 1% & 3% | |
| | | | COLOR: | | TBD | |
| | | | FASCIA: | | CLEAR ANODIZED W/END CAPS | |
| | | | OPERATION: | | STST BEAD CHAIN | |
| | | | LOCATION: | | STUDENT LOUNGE, REFER TO A2.2 | |
| | | | | | | |
| 123550 | | INSTITUTIONAL CASEWORK | | | | |
| | HPL1 | HIGH PRESSURE LAMINATE | MFR.: | | WILSONART | |
| | | COUNTERTOPS | COLOR: | | GOLDEN MESH | |
| | | | NO: | | 4912-38 | |
| | | | FINISH: | | FINE VELVET | |
| | | | LOCATION: | | TYPICAL COUNTERS | |
| | | | | | | |
| | HPL2 | HIGH PRESSURE LAMINATE | MFR.: | | WILSONART | |
| | | BASE & WALL CABINETS | COLOR: | | STEEL MESH | |
| | | | NO: | | 4879-38 | |
| | | | FINISH: | | FINE VELVET | |
| | | | LOCATION: | | TYPICAL BASE/WALL CABINETS | |
| 14 2010 | HPL5 | HIGH PRESSURE LAMINATE | MFR.: | | TBD | |
| 1 1 2010 | I II LO | ELEVATOR CAB | COLOR: | | TBD | |
| | 1 | LLL F, GOR GAD | NO: | | TBD | |
| | 1 | | FINISH: | | TBD | |
| | 1 | | LOCATION: | | ELEVATOR CAB | |
| | 1 | | LOCATION. | | LEET, WOR OND | |

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing. non-loadbearing.
- B. Metal channel ceiling framing.
- C. Sound Attenuation Batts / Acoustic insulation.
- D. Gypsum sheathing.
- E. Gypsum wallboard.
- F. Glass mat faced gypsum board.
- G. Joint treatment and accessories.
- H. Fiberglass reinforced plastic (FRP) wall panels.
- I. Suspended gypsum board on track/grid.
- J. Specialty reveals.
- K. Products installed, but not furnished, under this Section include the following:
 - 1. Access panels to be furnished by, but not limited to the following; mechanical, electrical, plumbing, controls, communication/data contractors.

1.02 RELATED REQUIREMENTS

- A. Section 054000 Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
- B. Section 061000 Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 072100 Thermal Insulation: Thermal insulation.
- D. Section 078400 Firestopping: Top-of-wall assemblies at fire rated walls.
- E. Section 079005 Joint Sealers: Acoustic sealant/sound caulk.
- F. Section 083100 Access Doors and Panels: Access panels in partitions and ceilings.
- G. Section 102601 Wall and Corner Guards: Standard corner guards.

1.03 REFERENCE STANDARDS

- A. AISI S100-12 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM C475/C475M Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- D. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014.
- E. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- F. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- G. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board; 2013.

- H. ASTM C954 Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- I. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- J. ASTM C1047 Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- K. ASTM C1177/C1177M Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- L. ASTM C1280 Standard Specification for Application of Gypsum Sheathing Board; 2013.
- M. ASTM C1396/C1396M Standard Specification for Gypsum Board; 2014.
- N. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- O. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- P. GA-214 Recommended Levels of Finish for Gypsum Board, Glass Mat and Fiber-Reinforced Gypsum Panels; 2015
- Q. GA-216 Application and Finishing of Gypsum Board; 2013.
- R. GA-226 Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.
- S. GA-253 Recommended Specifications for the Application of Gypsum Sheathing; Gypsum Association; 1999.
- T. GA-600 Fire Resistance Design Manual; 2015.
- U. GA-801 Handling of Storage of Gypsum Panel Products; current edition.
- V. ICC (IBC) International Building Code; 2015.
- W. UL (FRD) Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system, FRP panels, and reveals.
- B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- C. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

- A. Perform in accordance with ASTM C840 and GA-214 and GA-216. Comply with requirements of GA-600 for fire-rated assemblies.
- B. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packaging, containers or bundles bearing the manufacturers brand name and identification.
- B. Store materials inside and under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.
- C. Stack panels flat to prevent sagging.
- D. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim form being bent or damaged.
- E. In addition follow the guidelines found in GA-801.
- F. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 or GA-216 requirements, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet or moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840, GA-214 and GA-216.
 - 1. See PART 3 for finishing requirements.

2.02 METAL FRAMING MATERIALS

- A. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following;
 - 1. Metal Framing, Connectors, and Accessories:
 - a. Clark Dietrich Building Systems: www.dietrich.com
 - b. J. N. Linrose Manufacturing LLC: www.jnlinrose.com
 - c. Marino Ware: www.marinoware.com.
 - d. Mill Steel Framing: www.millsteelframing.com
 - e. Phillips Manufacturing Company: www.phillipsmfg.com.
 - f. Southeastern Stud and Components, Inc: www.sestud.com
 - g. Telling Industries, LLC: www.tellingindustries.com.
- B. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following;
 - Drywall Suspension Systems and Accessories: Contractor's option to use a drywall suspension system for the gypsum board ceilings in lieu of metal stud ceiling framing.
 - a. Armstrong Commercial Ceilings: www.armstrong.com
 - b. USG: www.usg.com
 - c. Chicago Metallic Corporation: www.chicago-metallic.com

- C. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Minimum recycled content of 30%. Preference shall be given for steel framing components containing locally recovered steel.
 - 2. All Framing and System Components: Minimum G40 zinc-coated hot dipped galvanized steel, per ASTM A 653 or coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120) coating, roll-formed from steel meeting mechanical and chemical requirements of ASTM A 1003 with a zinc-based coating. Galvannealed products are not acceptable.
 - a. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
 - b. Equivalent Gauge Thickness for Steel Studs and Runner: Members that can show certified third party testing with gypsum board in accordance with ICC ES AC86 (current edition) need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C645. The submission of an evaluation report is acceptable to show conformance to this requirement.
 - 1) Clark Dietrich Building System ProStud: www.clarkdietrich.com.
 - 2) Marino\Ware Viper Stud: www.marinoware.com
 - 3. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 4. Runners: U shaped, sized to match studs.
 - 5. Ceiling Channels: C-shaped.
 - 6. Furring: Hat-shaped sections, minimum depth of 7/8 inch
- D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- E. Partition Head to Structure Connections: Contractor option to friction fit slip leg track or track with slotted holes as specified below:
 - 1. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
 - 2. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - a. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 - b. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
- F. Drywall Grid System: Grid system meeting ASTM C 635 and ASTM C 645 Standard Specification for Rigid Furring Channels for Screw Applications of Gypsum Board.
 - 1. Contractor option to use this system in lieu of framed construction.
 - 2. Intermediate-duty main beam, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height of 1-11/16" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.
 - 3. Cross-tees, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height 1-1/2" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.
 - 4. Wall moldings, galvanized steel, hemmed angle, nominal 1-1/4" x 1-1/4".
 - 5. Hanger wire, minimum 12 gauge and spaced along main beam not more than 4' on center to support load.
 - 6. Add vertical bracing as required to stabilize the frame.
 - 7. Product to have manufacturers 10-year limited warranty.

2.03 BOARD MATERIALS

- A. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following;
- B. Manufacturers Gypsum-Based Board:
 - 1. Saint-Gobain BPB/Certainteed Inc: www.bpb-na.com.
 - 2. Georgia-Pacific Gypsum(acquired Temple Inland): www.gpgypsum.com.
 - 3. Continental Building Products: www.continental-bp.com.
 - 4. National Gypsum Company: www.nationalgypsum.com/#sle.
 - 5. USG Corporation: www.usg.com/#sle.
- C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings and soffits, unless otherwise indicated.
 - 2. Thickness: 1/2 inch.
 - 3. Edges: Tapered.
 - 4. Products:
 - a. CertainTeed Corporation; Interior Ceiling Drywall: www.certainteed.com/#sle.
 - b. Continental Building Products; Sagcheck: www.continental-bp.com.
 - c. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
 - d. National Gypsum Company; High Strength Brand Ceiling Board.
 - e. Temple-Inland Building Products by Georgia-Pacific, LLC; Span24 Ceiling Board.
 - f. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
- D. Gypsum Wallboard: ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.
 - 1. Regular Type:
 - a. Application: Use for vertical surfaces, unless otherwise indicated.
 - b. Thickness: 5/8 inch.
 - c. Edges: Tapered.
 - d. Application: Where required for fire-rated assemblies, unless otherwise indicated.
 - 2. Fire Resistant Type: Complying with Type X requirements; UL or WH rated.
 - a. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
 - b. Application: Where required for fire-rated assemblies, unless otherwise indicated.
 - c. Thickness: 5/8 inch.
 - d. Edges: Tapered.
- E. Abuse-Resistant Type: Gypsum wallboard especially formulated for increased impact resistance, with enhanced gypsum core and heavy duty face and back paper.
 - 1. Application: High-traffic areas indicated.
 - 2. Core Type: Regular and Type X, as indicated.
 - 3. Thickness: 5/8 inch.
 - 4. Edges: Tapered.
 - 5. Recycled Content: Minimum 80% recycled gypsum and 95% recycled content face paper.
 - 6. Local Materials: Manufactured and of raw materials from within 500 miles of Project Site.
 - a. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1) Certainteed/Saint Gobain AirRenew Extreme Abuse
 - 2) Continental Building Products Protecta HIR 300
 - 3) USG FiberRock Abuse Resistant: www.usg.com
 - 4) National Gypsum High Abuse XP: www.nationalgypsum.com
 - 5) GP/Temple-Inland ComfortGuard AR: www.templeinland.com

- F. Mold-Moisture/Water-Resistant/Abuse Gypsum Backing Board: ASTM C 1396/C 1396M; ends square cut.
 - 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 - 2. Edges: Tapered.
 - a. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1) Certainteed/Saint Gobain Extreme Abuse with M2 Technology
 - 2) Continental Building Products Protecta HIR 300
 - 3) USG FiberRock Aqua-Tough or Mold Tough Abuse Resistant: www.usg.com
 - 4) National Gypsum Gold Bond High Abuse XP: www.nationalgypsum.com
 - 5) GP/Temple-Inland ComfortGuard: www.templeinland.com
- G. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
 - 1. Application: Exterior sheathing, unless otherwise indicated.
 - Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 - 3. Core Type: Regular.
 - 4. Regular Board Thickness: 5/8 inch.
 - 5. Edges: Square.
 - 6. Glass Mat Faced Products:
 - a. CertainTeed Corporation; GlasRoc Exterior Sheathing.
 - b. Continental Building Products; Weather Defense Platinum Exterior Sheathing.
 - c. Saint Gobain Certainteed: GlassRoc.
 - d. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - e. National Gypsum Company; Gold Bond eXP Sheathing.
 - f. Temple-Inland Building Products by Georgia-Pacific, LLC; GreenGlass Exterior Sheathing.
 - g. USG Corporation: Securock Glass-Mat Sheathing
- H. Exterior Roof Board: Sizes to minimize joints in place; ends square cut.
 - 1. Application: Roof board at parapet walls, unless otherwise indicated.
 - a. Installer/supplier of roof board to coordinate with roofing manufacturer/installer to ensure that roof board selected (fiber-glass faced and/or unfaced/gypsum-fiber board or plywood sheathing per section 061000) meets the roof manufacturers warranty requirements as described in section 075400 Thermoplastic Membrane Roofing.
 - 2. Glass-Mat-Faced Board: Glass mat faced gypsum substrate as defined in ASTM C 1177/C 1177M.
 - 3. Unfaced/Gypsum-Fiber Board: Gypsum-fiber substrate as defined in ASTM C 1278.
 - 4. Core Type: Regular.
 - 5. Board Thickness: 5/8 inch.
 - 6. Edges: Square, for vertical application.
 - 7. Glass-Mat-Faced Roof Board Products:
 - a. Georgia-Pacific Gypsum LLC; DensDek Prime
 - 8. Unfaced/Gypsum-Fiber Roof Board Products:
 - a. United States Gypsum Co.; Securock Roof Board

2.04 FIBERGLASS REINFORCED BOARD MATERIALS

- A. Glass Mat Gypsum Board: Gypsum panels with moisture-resistant core and coated inorganic fiberglass mat back surface designed to resist growth of mold and mildew, per ASTM D 3273.
 - Glass Mat Board: Comply with performance requirements of ASTM C 1396/C 1396M for water-resistant gypsum backing board and ASTM C 1177/C 1177M for sheathing; tapered long edges.

- B. FRP (Fiberglass Reinforced Plastic) Wall Panels:
 - 1. FRP panel type: Sanitary.
 - 2. Fire rating: Class 1/C fire rating per ASTM E-84.
 - 3. Surface texture: Smooth.
 - 4. Wall Panel, Trim and Accessories Color: Selected by Architect from manufacturers standard color chart.
 - 5. Trim and Accessories: Extruded rigid PVC trim units and accessories as required for a complete installation including but not limited to inside and outside corners, edge trim, butt joint connectors and base molding.
 - 6. Adhesive: Provide manufacturer's recommended construction adhesives.
 - 7. Sealant: Provide manufacturer's recommended sealant to completely seal all seams and trim intersections
 - 8. Panel Size: 48" x minimum 96".
 - 9. Panel Thickness: 3/32" (0.09") nominal.
 - 10. Panel Physical Properties:
 - a. Flexural Strengths: 10,000 psi
 - b. Flexural Modulus: 3,100,000 psi
 - c. Tensile Strengths: 7000 psi
 - d. Barcol Hardness: 35
 - e. Izod Impact Strength: 7.0-7.2 ft#/in
 - f. Thermal Coefficient of Lineal expansion: 15,700,000 in/in/F degrees
 - g. Water Absorption: .72%
 - h. Specific Gravity: 1.50 1.80
 - i. Flame Spread: <25
 - j. Smoke Generation: <450
 - 11. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - a. Marlite Marlite Standard FR Class 1/C: www.marlite.com
 - b. Crane Composites Glasbord Class C: www.cranecomposites.com
 - c. NUDO FiberLite Class C: www.nudo.com
 - d. Stabilit America; Glasteel Glasliner FRP Class 1/C: www.glasteel.com

2.05 REVEALS AND TRIMS

- A. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1. Flannery, Inc.: www.flannerytrim.com
 - 2. Fry Reglet: www.fryreglet.com
 - 3. Gordon Inc.: www.gordonceilings.com
 - 4. Pittcon Industries: www.pittconindustries.com
- B. Specialty Reveal Type 1: Fry Reglet Reveal Molding DCS-50-200. Reveal to be extruded alloy 6063 T5 with clear anodized finish. Provide factory mitered intersections.
- C. Specialty Reveal Type 2: Fry Reglet Reveal Molding DRMPET-100. Reveal to be extruded alloy 6063 T5 with clear anodized finish. Provide factory mitered intersections.

2.06 ACCESSORIES

A. Sound Attenuation Batts/Blankets/Acoustic Insulation: ASTM C 665; 2.5 pcf nominal density, preformed mineral-fiber, friction fit type, unfaced. Fiber glass sound control batt insulation, unfaced, and must meet the performance requirements of ASTM C 665 "Standard Specification for Mineral Fiber Blanket, Thermal Insulation.

- 1. Sound Attenuation Batts/Blankets/Acoustic Insulation: ASTM C 665; 2.5 pcf nominal density, preformed mineral-fiber, creased, friction fit type, unfaced. Creased batt width to be one inch wider than the on-center spacing of the studs. Refer to drawings for stud spacing.
 - a. Contractor option to provide creased batts/blankets or support batts/blankets with "tiger teeth, lightning rods, or wire stays" between studs or support batts with metal banding attached to the metal studs or metal wire threaded through the stud openings in a continuous manner.
 - 1) Acceptable Metal Banding Product:
 - (a) Insul-Hold Co., Inc. Insul-Hold: www.insulhold.com
 - (1) Class D, ASTM 527-80, 24 gauge galvanized metal strapping with two-three inch long arrows to secure insulation.
- 2. Contractor option to use one of the following products:
 - a. Mineral-Fiber Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1) Owens Corning Thermafiber SAFB: www.thermafiber.com
 - 2) Roxul Inc. Roxul AFB: www.roxul.com
 - b. Fiber Glass Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1) JM -Sound Control Batts: www.jm.com
 - 2) Owens Corning ProPink Sound Attenuation Batts: www.owenscorning.com
- B. Sound Attenuation Batts/Blanket Product Requirements:
 - 1. Sound Attenuation Batts/Blankets/Acoustic Insulation Thickness: Minimum thickness 3 inch at 3-5/8" metal stud walls.
 - 2. Sound Attenuation Batts/Blankets/Acoustic Insulation Thickness: Minimum thickness 6 inch at 6 inch metal stud walls.
 - 3. Sound Attenuation Batts/Blankets/ Acoustic Insulation Width: Minimum width to be the same as the on-center stud spacing indicated on the drawings.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Ready-mixed vinyl-based joint compound.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
- G. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.
- H. Screws: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.
- I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- J. Compressible Filler: In lieu of coping gypsum board to deck profile and providing sound attenuation blanket material and acoustical sealant it is the contractor's option to provide and install cut to fit or premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, EPDM, or PVC.

- 1. Install at tops of non-rated, non-load-bearing metal stud walls running perpendicular or parallel to the metal deck. Place a bead of caulk 1/2 inch back from flute opening and on all sides of flute. Compress plug and slide into place.
 - a. Perpendicular to metal deck: Williams Products Inc. EVA 200G or 3000 Series Closure Flute Plugs or Strips: www.williamsproducts.net.
 - Closed Cell plugs and strips per ASTM D-1171, ASTM D-925, ASTM D-412. Density: 12.8 lbs/ft

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling and soffit system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
- C. Studs: Space studs as indicated on the drawings.
 - 1. Align and secure top and bottom runners at 24 inches on center.
 - 2. Install studs vertically.
 - 3. Align stud web openings horizontally.
 - 4. Stud splicing is not permissible.
 - 5. Extend partition framing to underside of floor or roof deck. Attach extended leg top runner to deck, maintain clearance between top of studs and runner, and brace both flanges of studs with continuous bridging.
 - 6. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track. Contractor option to use slotted track.
- D. Corners: Fabricate corners using a minimum of three studs.
- E. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- F. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- G. Brace stud framing system rigid.
- H. Access Panel Opening Framing: Coordinate with the following, but not limited to; mechanical, electrical, plumbing, communication/data contractors for access panel locations in walls and ceilings.
 - 1. If access panels are being furnished by other trades verify type of access panel being provided, and if gypsum board on the recess door panel is required.
- I. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
- J. Blocking: See Section 061000 for wood blocking. Install wood blocking for support of:
 - 1. Cabinets, shelf, and countertop supports.
 - 2. Wall mounted cabinets.
 - Wall brackets.
 - 4. Handrails and guardrails.
 - 5. Fire extinguisher cabinets, brackets, and valve cabinets.

- 6. Grab bars.
- 7. Toilet and bath accessories.
- 8. Toilet and urinal partitions.
- 9. Wall-mounted door hardware and stops.
- 10. Chalkboards, tackboards, and marker boards.
- 11. Wall paneling and trim.
- 12. Joints of rigid wall coverings that occur between studs.
- 13. Locker base and wall attachment.
- 14. Interior and exterior wall openings to receive metal frame system; window, door, etc.
- 15. Access panels.
- 16. Framed openings.
- 17. Plumbing fixtures.
- 18. Ceiling mounted projection screens and projector mounts.
- 19. Wall mounted projection screens and projector mounts.
- Wall and ceiling mounted items indicated as N.I.C. and/or Owner provided and Owner installed.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Sound Attenuation Batts /Acoustic Insulation: Friction fit, by placing tightly within on-center stud spacing, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant/Sound Caulk: Install per requirements of 079005 Joint Sealers

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
- C. Glass Mat Faced Gypsum Board: Install in strict accordance with manufacturer's instructions.
- D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- E. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.

3.06 LEVELS OF GYPSUM BOARD FINISH

- A. Paper Faced Gypsum Board: Use paper or fiberglass joint tape, bedded with powder-type or ready-mixed vinyl-based joint compound and finished with powder-type or ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in GA-214 and ASTM C 840, as follows:
 - 1. Level 5: Walls to receive eggshell, semi-gloss, gloss paint or wallcovering.
 - a. All regularly inhabited rooms or areas.
 - 2. Level 4: Walls, ceilings and soffits to receive flat, eggshell, semi-gloss or gloss paint.
 - 3. Level 2: Behind cabinetry, FRP panels in janitorial/custodial rooms and on backing board to receive tile finish.

- 4. Level 1: Fire rated wall and non-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - 3. Taping, filling and sanding is not required at base layer of double layer applications.
- D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092116

SECTION 093000 - TILING

PART 1-GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Unglazed quarry tile and base (QT1) (including cooler and freezer locations)
 - 2. Porcelain paver tile
 - 3. Setting and grouting materials
 - 4. Transition strips
 - 5. Self-leveling system comprised of clips & wedges
 - 6. Note: Work of this section includes patching and repairing the floor slab as required to provide a suitable substrate to receive tile.

1.02 RELATED REQUIREMENTS

- A. Section 012300 Alternates: Refer to section for additional information.
- B. Section 013000 Administrative Requirements Submittal procedures
- C. Section 079005 Joint Sealers: Acoustic sealant/sound caulk
- D. Section 090050 Finish Legend
- E. Section 092116 Gypsum Board Assemblies: Tile backer board
- F. Section 224000 Plumbing Fixtures: Shower receptor

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ANSI A108.10 American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- C. ANSI A108.11 American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- D. ANSI A118.12 American National Standard Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation; 2014.
- E. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- F. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- G. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board; 2013.
- H. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- J. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride;2011.
- K. ICC (IBC) International Building Code; 2012, with Kentucky Amendments; current edition.
- L. TCNA (HB) Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.
- M. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data: Provide manufacturer's data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop drawings indicating tile patterns and locations and widths of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
 - 1. Locate precisely each joint and crack in tile substrates by measuring, record measurements on shop drawings, and coordinate them with tile joint locations, in consultation with Architect.
- D. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors, textures, and patterns available for each type and composition of tile indicated. Include samples of grout and accessories involving color selection.
- E. Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated, products involve color and texture variations, in sets showing full range of variations expected.
 - 1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.
 - 2. Full-size units of each type of trim and accessory for each color required.
- F. Master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- G. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile and tile setting and grouting products with requirements indicated.
- H. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.
- I. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 016000 Product Requirements, for additional information.

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
- C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings".
- E. Maintain one copy of ANSI A108/A118/A136.1 and TCNA (HB) on site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at 50 deg F (10 deg C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.10 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
 - 1. Unglazed Quarry Tile:
 - a. American OLean
 - b. Dal-Tile Corp.
 - c. Florida Tile
 - 2. Porcelain Tile:
 - a. Basis of Design: Florida Tile
 - b. American Olean Tile Co., Inc.
 - c. Dal-Tile Corp.
 - 3. Latex-Emulsion Based-Portland Cement Mortars:
 - a. Boiardi Products Corp.
 - b. Bostik Construction Products Div.

- c. C-Cure Chemical Co.
- d. Custom Building Products
- e. Dal-Tile Corp.
- f. DAP, Inc. Div.; USG Corp.
- g. H.B. Fuller
- h. Laticrete International, Inc.
- i. L&M Mfg., Inc.
- 4. High Performance Grout:
 - a. TEC Power Grout 550

2.02 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.
 - 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Provide porcelain paver selections by interior designer.
 - 2. Provide tile trim and accessories that match color and finish of adjoining flat tile unless otherwise indicated.
 - 3. Provide quarry tile selections by interior designer.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.
- F. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of uses and has been successfully used on other projects.
- G. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.03 TILE PRODUCTS

- A. Ceramic or Porcelain Tile-Floor Tile & 4" Wall Base
 - 1. MFR: Florida Tile
 - 2. Style: Tides
 - 3. Color: Sand Castle
 - 4. Size: 12" x 24"
 - 5. Grout: TEC Powerrgrout
 - 6. Grout Color: TBD
 - 7. Installation: Stack Bond
 - 8. Accessories:
 - a. Provide Schluter -Jolly brushed stainless steel on all outside corners & on top of the cut wall base
 - b. Floor tile in restrooms
 - 9. Location: Floor tile in restrooms

- B. Unglazed Quarry Tile-Floor Tile & Base:
 - 1. MFR: American OLean
 - 2. Style: QuarryNaturals
 - 3. Color: Shadow Gray
 - 4. Size: 8" x 8"-Tile 5" x 8"-Base
 - 5. Grout: TEC Powergrout
 - 6. Grout Color: TBD
 - 7. Installation: Monolithic
 - 8. Location: Cooler/Freezer
- C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:
 - 1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
 - 2. Shapes: As follows, selected from manufacturer's standard shapes:
 - a. Base for Thinset Mortar Installations: Coved.
 - b. External Corners for Thinset Installations: Surface bullnose.
 - c. Internal Corners: Field-butted square corners, except use coved base and cap angle pieces designed to member with stretcher shapes.

2.04 SETTING & GROUTING MATERIALS

- A. Portland Cement Mortar Installation Materials: Provide materials to comply with ANSI A108.1 as required for installation method designated, unless otherwise indicated.
- B. Latex-Portland Cement Mortar: Provide product complying with ANSI A108.1 and the following requirement for composition:
 - 1. Prepackaged dry mortar mix incorporating dry polymer additive in the form of a re-emulsifiable powder to which only water is added at the job site.
 - 2. Latex additive (water emulsion) of type described below, serving as a replacement for part or all of gauging water, added at job site to prepackaged dry mortar mix supplied or specified by latex manufacturer.
 - a. Latex Type: Manufacturer's standard.
- C. Grouting Materials:
 - 1. Dry Set Grout: Provide product complying with ANSI A118.6 of color indicated.
 - 2. Prepackaged Dry Grout Mix incorporating dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
 - 3. Grout Additive: Grout Boost Advanced Pro by H.B. Fuller Construction Products, Inc. Follow all manufacturer's instructions.
 - 4. Latex Additive (water emulsion) serving as a replacement for part or all of gauging water, added at job site to prepackaged dry grout mix, with type of latex and dry grout mix complying with requirements indicated below:
 - a. Latex Type: Manufacturer's Standard.
 - b. Grout Type: Dry-set grout specified or supplied by latex manufacturer. Use latex additive without a retarder with dry-set grout.
 - c. Application: Use to grout joints in floor and wall tile unless otherwise indicated. Note: Grout joints shall be 1/8" wide and the epoxy grout shall fill the joint space and be no lower than 1/32" of an inch from the top face of the tile.

2.05 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with requirements of Division 7 Section "Joint Sealers," including ASTM C 920 as referenced by Type, Grade, Class, and Uses.

- B. The quarry tile and unglazed mosaic tile shall be sealed before grouting with Aqua Mix Inc. penetrating sealer following manufacturer's application recommendations.
- C. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- D. Multipart Pourable Urethane Sealant for Use T: Type M; Grade P; Class 25; Uses T, M, A, and as applicable to joint substrates indicated, O.
- E. Products: Subject to compliance with requirements, manufacturers offering products which may be incorporated into the Work include, but are not limited to, the following:
 - 1. Multipart Pourable Urethane Sealant:
 - a. "Chem-Calk 550"; Bostik Construction Products Div.
 - b. "Vulkem 245"; Mameco International, Inc.
 - c. "Urexpan NR-200"; Pecora Corp.
 - d. "THC-900"; Tremco Corp.

2.06 MISCELLANEOUS MATERIALS

- A. Transition Strips: Provide a metal stepless transition strip to match Schluter-Reno U or TK Series (or approved equivalent) at all exposed edges of tile installation.
- B. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout, is compatible with tile and mortar/grout products, and is easily removable after grouting is completed without damaging grout or tile.
 - 1. Petroleum paraffin wax, fully refined, tasteless, odorless, containing at least 0.5 percent oil with a melting point of 120 deg F (49 deg C) to 140 deg F (60 deg C) per ASTM D 87.
 - 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.
- C. Self-Leveling System: Provide two-part leveling clips and wedges (1/8") as manufactured by one of the following:
 - 1. Raimondi Leveling Solutions
 - 2. Tuscan Leveling System
 - 3. QEP Lash System

2.07 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- B. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:
 - 1. Petroleum paraffin wax or grout release.
- C. Protect surrounding work from damage.
- D. Vacuum clean surfaces and damp clean.
- E. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- F. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- G. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.
- B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
- E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
- F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealers."

G. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113 or F116 (epoxy).
 - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122.
 - Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.
- B. Over wood substrates, install in accordance with TCNA (HB) Method F150.
- C. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.
- D. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- E. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- F. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces. **END OF SECTION**

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1-GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Acoustical panels Type APC-1 (24" x 24")
 - 2. Washable faced gypsum panel ceiling Type APC-2 (24" x 24")
 - 3. Exposed suspension system (15/16")
- B. All acoustical panel ceiling components and installation methods shall comply with seismic zone requirements of the Kentucky Building Code.
- C. Refer to the Room Finish Schedule on Sheets A2.1 & A2.2 and the Ceiling Legend and Reflected Ceiling Plan on Sheets A7.1 & A7.2 for the locations of acoustical ceiling tile and grid types.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-In-Place Concrete: Placement of special anchors or inserts for suspension system
- B. Section 053100 Steel Decking: Placement of special anchors or inserts for suspension system
- C. Section 090050 Finish Legend
- D. Section 211300 Fire Suppression Sprinkler System: Sprinkler heads in ceiling system
- E. Section 233700 Air Outlets and Inlets: Air diffusion devices in ceiling
- F. Section 265100 Interior Lighting: Light fixtures in ceiling system
- G. Section 275116 Public Address Systems: Speakers in ceiling system
- H. Section 284600 Fire Detection and Alarm: Fire alarm components in ceiling system

1.03 DEFINITIONS

- A. CAC: Ceiling Attenuation Class.
- B. LR: Light Reflectance coefficient.
- C. NRC: Noise Reduction Coefficient.

1.04 REFERENCE STANDARDS

- A. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2009a.
- B. ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- C. ASTM C636/C636M Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- D. ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- E. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2005 (Reapproved 2012).
- F. ASTM E1264 Standard Classification for Acoustical Ceiling Products; 2014.
- G. CAL (CHPS LEM) Low-Emitting Materials Product List; California Collaborative for High Performance Schools (CHPS); current edition at www.chps.net/.

- H. GEI (SCH) GREENGUARD "Children and Schools" Certified Products; GREENGUARD Environmental Institute; current listings at www.greenguard.org.
- I. NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.
- J. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.
- K. UL (GGG) GREENGUARD Gold Certified Products; current listings at http://http://productguide.ulenvironment.com/QuickSearch.aspx.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: One set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: One set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
- E. Qualification Data: For testing agency.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- G. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor type.
- H. Maintenance Data: For finishes to include in maintenance manuals.
- I. NRC: Noise Reduction Coefficient.

1.06 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations
 - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended

1.09 SEQUENCING AND SCHEDULING

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equivalent to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equivalent to 2.0 percent of quantity installed.

PART 2-PRODUCTS

2.01 WARRANTIES

A. Panels shall not sag for 15 years. No limit to relative humidity, short of standing water and up to 120 degrees Fahrenheit.

2.02 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.03 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.04 MINERAL-BASE ACOUSTICAL PANELS

- A. Ceiling Type APC-1: (24" x 24" x 3/4")
 - Products:
 - a. Armstrong's School Zone Fine Fissured No. 1713
 - b. USG: "Clima Plus" High NRC No. 22421
 - c. CertainTeed "Fine Fissured"
 - 2. Classification: Provide Class A panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type III, Form 2
 - b. Pattern: CE (lightly textured)
 - 3. Color: White
 - 4. LR: Not less than 0.84
 - 5. NRC: Not less than 0.70, U.L. classified label on each carton
 - 6. CAC: Not less than 35, U.L. classified label on each carton
 - 7. Edge Detail: Square
 - 8. Antimicrobial Treatment: Coating based to inhibit mold and mildew
 - 9. Panels shall exceed ASTM C367 ball hardness test to 210 lbs.

2.05 WASHABLE FACE PANEL CEILING

- A. Ceiling Type APC-3: (24" x 24" x 5/8")
 - 1. Products:
 - a. Armstrong's Kitchen Zone No. 673
 - b. Sheetrock Gypsum Ceiling Panel No. 3260
 - c. National Gypsum Gridstone No. GR5040
 - 2. Classification: Provide Class A panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type IX, Form 2
 - b. Pattern: G
 - 3. Color: White
 - 4. LR: Not less than 0.89
 - 5. NRC: N/A
 - 6. CAC: Not less than 33, U.L. classified label on each carton
 - 7. Edge Detail: Square
 - 8. Antimicrobial Treatment: Coating based to inhibit mold and mildew
 - 9. Panels shall exceed ASTM C 367 ball hardness test to 210 lbs.

2.06 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
 - 3. Wire hangers shall be installed on two diagonal corners of each 2' x 4' ceiling grid opening, or equivalent. Refer to the electrical specifications for information concerning the suspension system for ceiling mounted equipment.

2.07 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS

- A. Available Products:
 - 1. Armstrong Prelude XL
 - 2. USG DX/DXL 24 Series
 - 3. Chicago Metallic CMC 1200 Series
 - 4. Gordon, Inc.
- B. Wide-Face, Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges. Note: Kitchen 203, Food Prep 203A, Storage 203 B, & Dishwashing 203C require an aluminum cap faced grid system.
 - 1. Structural Classification: Intermediate-duty system
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type
 - 3. Face Design: Flat, flush
 - 4. Cap Material: Cold-rolled sheet
 - 5. Cap Finish: Painted white
 - 6. Width: 15/16"
 - 7. Corner trim: Pre-Manufactured
- C. Radius Wall/Soffit Surfaces: Radius wall surfaces only shall receive Ultra-Flex flexible acoustical ceiling trim as manufactured by the Kenbeck Company. The appearance of the Ultra-Flex angle trim shall match the other typical angle trim.
- D. Drywall Grid System: Grid system meeting ASTM C 635 and ASTM C 645 Standard Specification for Rigid Furring Channels for Screw Applications of Gypsum Board.
 - 1. Contractor option to use this system in lieu of framed construction.
 - 2. Intermediate-duty main beam, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height of 1-11/16" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.
 - 3. Cross-tees, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height 1-1/2" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.

- 4. Wall moldings, galvanized steel, hemmed angle, nominal 1-1/4" x 1-1/4".
- 5. Hanger wire, minimum 12 gauge and spaced along main beam not more than 4' on center to support load.
- 6. Add vertical bracing as required to stabilize the frame.
- 7. Product to have manufacturers 10-year limited warranty.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION, GENERAL

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 6. Do not attach hangers to steel deck tabs.
 - 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit. Where the unifinished/unpainted cut edge of a tile is exposed the edge shall be repainted to achieve a "finished" appearance.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Fit border trim neatly against abutting surfaces.
- B. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.

3.05 FIELD QUALITY CONTROL

- A. Remove and replace acoustical panel ceiling hangers where test results indicate that they do not comply with specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touch up of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096500 - RESILIENT TILE FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Solid vinyl tile.
 - 2. Static Disipative tile.
 - 3. The elevator cab shall receive solid vinyl tile.
 - 4. Note: Where resilient floor tile abut terrazzo flooring the resilient installer shall provide a feathered underlayment to provide a smooth transition area. The area of floor level transition shall occur over a minimum of three feet distance.
- B. Floor Slab Preparation: The installer is required to prepare all areas of floor slabs by utilizing a self leveling material equivalent to Mapei M-20 with T-2 primer, Schonox XM or TEC Level Set 300, as required over the entire floor surface. Following the manufacturer's directions completely before installing tiles. Some areas may require deeper fill material. Field verify existing conditions after demolition. Provide all required leveling materials and labor required to achieve a smooth surface.

1.02 RELATED REQUIREMENTS

- A. Section 013000 Administrative Requirements: Submittal procedures.
- B. Section 090050 Finish Legend.
- C. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base, reducer strips and other accessories installed with resilient floor tile.

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. Product data for each type of product specified.
- B. Samples for Initial Selection: For each type of resilient floor tile indicated.
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.07 PROJECT CONDITIONS

- A. Substrate Conditions: Use the method described below to determine the dryness as required to ensure initial and long-term success.
 - 1. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using In Situ Probes.
 - a. Three tests should be conducted for areas up to 1,000 square feet and one additional test should be conducted for each additional 1,000 square feet of flooring.
 - b. Results must not exceed 75% when tested to ASTM F 2170. A diagram of the area showing the location and results of each test shall be submitted to the Interior Designer/Architect. If the test results exceed the limitations, the installer must not proceed until the problem has been corrected.
- B. The flooring contractor shall verify in writing to the owner, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions:
 - 1. Moisture: Initial emission rate, as tested with a calcium chloride test kit, per ASTM F 1869-89 requirements.
 - 2. Alkalinity: Maximum pH of 9.
- C. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- D. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- E. Close spaces to traffic during floor covering installation.
- F. Close spaces to traffic for 48 hours after floor covering installation.
- G. Install resilient products after other finishing operations, including painting, have been completed.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color and pattern of floor tile installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design: Armstrong World Industries: Static Disipative tile
 - 2. Basis of Design: Tarkett Cortina Grande
 - 3. Congoleum
- B. Available Manufacturers: Other manufacturers proposed which meet the specific standards specified shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.02 COLORS AND PATTERNS

Colors and Patterns: As selected by Interior Designer from manufacturer's full range.

2.03 SOLID VINYL COMPOSITION TILE ADDITIONAL REQUIREMENTS

- A. Mfr: Tarkett
- B. Style: Cortina Grande
- C. Color: 509 Campy
- D. Size: 16" by 16"
- E. Total Thickness: 0.125 (3.18mm)
- F. Installation: Glue Down, One Direction
- G. Location: Refer to Room Finish Schedules located on A2.1 and A2.2
- H. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648

2.04 STATIC DISIPATIVE TILE REQUIREMENT

- A. Resilient Tile Flooring: Static Disipative Tile (SDT1)
 - 1. MFR: Armstrong
 - 2. Style: Static Dissapative Tile
 - 3. Color: 51953 Pearl White
 - 4. Size: 12" x 12"
 - 5. Installation: Glue down, one direction
 - 6. Location: IT Closet

2.05 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Taylor Dynamic, 99% RH Adhesive: Water-resistant type approved by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale and foreign deposits that might interfere with adhesion of resilient products.
 - 2. The flooring Contractor shall prepare floor slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM E 710.
 - 1. Where irregular slab conditions occur, utilize POZ patch self leveling material as required (or approved equivalent) to return the slab to a smooth, level surface.
 - 2. Verify that substrates are dry and free of curing compounds, sealers and hardeners.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- E. Use trowelable leveling and patching compound to fill cracks, holes and depressions in substrates. Prepare all slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
- F. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- G. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- H. Where any concrete slab expansion material has been utilized adjacent to walls, columns, etc. and the thickness exceeds 1/4" out from the vertical surface. The flooring installer shall remove the expansion material and clean out the void in the floor surface. The installer shall then place a 1/4" thick removable spacer along the vertical surface and fill the remaining void with POZ self-leveling material (or approved equivalent). After the leveling material has cured, remove the 1/4" spacer and install tile per manufacturer's recommendations.

3.03 TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter.
- B. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles square with room axis unless otherwise indicated.

- C. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, including pipes, outlets, edgings, door frames, thresholds and nosings. Ties shall be installed under cabinets and casework.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
- F. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters..
- G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, and puckering at joints. Telegraphing of adhesive spreader marks and other surface imperfections.
- H. Maintain tile coursing, ensure that all tile coursing runs true and even, at no time shall coursing be allowed to "grow" or "shrink" causing uneven joints. Notify Designer/Architect of problems with the tile sizes.
- I. Where floor tile borders/patterns occur, the center "field" tiles shall be full size tiles and the border tiles along the wall shall be cut to center the field tiles.

3.04 SEQUENCING AND SCHEDULING

- A. Install tiles and accessories per the work schedule set by the General Contractor.
- B. Do not install tiles over concrete slabs or areas of patching until all areas are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

3.05 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.
 - 1. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 - 2. Do not move heavy and sharp objects directly over surfaces. Place hard board or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

SECTION 096502 - RESILIENT TILE FLOORING- LUXURY VINYL TILE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Luxury vinyl flooring
 - 2. Note: Where luxury resilient floor tile abut terrazzo flooring the resilient installer shall provide a feathered underlayment to provide a smooth transition area. The area of floor level transition shall occur over a minimum of three feet distance.
- B. Floor Slab Preparation: The installer is required to prepare all areas of floor slabs by utilizing a self leveling material equivalent to Mapei M-20 with T-2 primer and Schonox XM as required over the entire floor surface. Following the manufacturer's directions completely before installing tiles. some areas may require deeper fill material. Field verify existing conditions after demolition. Provide all required leveling materials and labor required to achieve a smooth surface.

1.02 RELATED REQUIREMENTS

- A. Section 013000 Administrative Requirements Submittal procedures
- B. Section 096513 Resilient Wall Base and Accessories, for resilient wall base, reducer strips and other accessories installed with resilient floor tile
- C. Section 012300 Alternates: Refer to section for additional information.
- D. Section 090050 Finish Legend

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. Product data for each type of product specified
- B. Samples for Initial Selection: For each type of resilient floor tile indicated
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required
- D. Maintenance Data: For resilient products to include in maintenance manuals

1.05 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.07 PROJECT CONDITIONS

- A. Substrate Conditions: Use the method described below to determine the dryness as required to ensure initial and long-term success.
 - ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using In Situ Probes
 - a. Three tests should be conducted for areas up to 1,000 square feet and one additional test should be conducted for each additional 1,000 square feet of flooring.
 - b. Results must not exceed 75% when tested to ASTM F 2170. A diagram of the area showing the location and results of each test shall be submitted to the Interior Designer/Architect. If the test results exceed the limitations, the installer must not proceed until the problem has been corrected.
- B. The flooring contractor shall verify in writing to the owner, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions:
 - 1. Moisture: Initial emission rate, as tested with a calcium chloride test kit, per ASTM F 1869-89 requirements
 - 2. Alkalinity: Maximum pH of 9
- C. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation
 - 2. During installation
 - 3. 48 hours after installation
- D. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- E. Close spaces to traffic during floor covering installation.
- F. Close spaces to traffic for 48 hours after floor covering installation.
- G. Install resilient products after other finishing operations, including painting, have been completed.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color and pattern of floor tile installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 LUXURY VINYL TILE

- A. Luxury vinyl tile: Shaw Terrain II
- B. Style: Number: 0454V
- C. Color: Ash
- D. Thickness: 0.5mm
- E. Size: 6" x 48"
- F. Wear Layer: 20 mil
- G. Finish: Exoguard
- H. Installation: Stagger
- I. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648
- J. Available Manufacturers: Other manufacturers proposed which meet the specific standards specified, shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.03 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Taylor Dynamic, 99% RH Adhesive: Water-resistant type approved by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale and foreign deposits that might interfere with adhesion of resilient products.
 - 2. The flooring Contractor shall prepare floor slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM E 710.
 - 1. Where irregular slab conditions occur, utilize POZ patch self leveling material as required (or approved equivalent) to return the slab to a smooth, level surface.
 - 2. Verify that substrates are dry and free of curing compounds, sealers and hardeners.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- E. Use trowelable leveling and patching compound to fill cracks, holes and depressions in substrates. Prepare all slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
- F. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed
- G. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter.
- B. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles square with room axis unless otherwise indicated.
- C. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, including pipes, outlets, edgings, door frames, thresholds and nosings. Ties shall be installed under cabinets and casework.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
- F. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas.

 Maintain overall continuity of color and pattern with pieces of flooring installed on these covers.

 Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, and puckering at joints. Telegraphing of adhesive spreader marks and other surface imperfections.
- H. Maintain tile coursing, ensure that all tile coursing runs true and even, at no time shall coursing be allowed to "grow" or "shrink" causing uneven joints. Notify Designer/Architect of problems with the tile sizes.

3.04 SEQUENCING AND SCHEDULING

- A. Install tiles and accessories per the work schedule set by the General Contractor.
- B. Do not install tiles over concrete slabs or areas of patching until all areas are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

3.05 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.
 - 1. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 - 2. Do not move heavy and sharp objects directly over surfaces. Place hard board or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - Resilient wall base rolls only. Refer to the drawings and the room finish schedule for additional information.
 - 2. Resilient flooring accessories

1.02 RELATED REQUIREMENTS

- A. Section 013000 Administrative Requirements Submittal procedures
- B. Section 090050 Finish Legend
- C. Section 096502 Resilient Tile Flooring

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
 - 1. Product data for each type of product specified
 - 2. Samples for initial selection purposes of manufacturer's standard sample sets in form of pieces cut from each type of product specified showing full range of colors and patterns available

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility for Products: Obtain each type and color of product specified from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- C. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.
- D. Smoke Density: Less than 450 per ASTM E 662.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- C. Move products into spaces where they will be installed at least 48 hours in advance of installation.

1.07 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive products specified in this Section for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).
- B. Do not install products until they are at the same temperature as that of the space where they are to be installed.
- C. Close spaces to traffic during installation of products specified in this Section.

1.08 SEQUENCING AND SCHEDULING

A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

1.09 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.
 - 1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof of each different type and color of resilient wall base installed, on a continuous roll. One roll per color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products specified in each Product Data Sheet at end of this Section.

2.02 RESILIENT WALL BASE

A. Vinyl Wall Base: Products complying with FS SS-W-40, Type I, and requirements specified in the Rubber Wall Base Product Data Sheet at end of this Section.

2.03 RESILIENT ACCESSORIES

A. Vinyl Accessories: Products complying with requirements specified in Vinyl Accessory Product Data Sheet at end of this Section.

2.04 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.

- B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland- cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- Adhesives: Water-resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas where installation of products specified in this Section will occur, with Installer present, to verify that substrates and conditions are satisfactory for installation and comply with manufacturer's requirements and those specified in this Section.

3.02 PREPARATION

- A. General: Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.
- B. Use trowelable leveling and patching compounds per manufacturers directions to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- D. Broom and vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.03 INSTALLATION

- General: Install products specified in this Section using methods indicated according to manufacturer's installation directions.
- B. All work required to put the wall and floor surface into acceptable condition to receive the specified products shall be the full responsibility of the installer. All surfaces shall be prepared to prevent the telegraphing of irregular substrate conditions onto/through the surface of the new wall base or other accessories.
- C. Apply resilient wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 2. Install inside and exterior corners before installing straight pieces.
 - 3. Form inside corners on job from straight pieces of maximum lengths possible by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce snug fit to substrate.
 - 4. Form outside corners on job from straight pieces of maximum lengths possible by shaving back of base at point where bending will occur. Remove a strip perpendicular to length of base and only deep enough to produce a snug fit without bends whitening or removal of more than half the thickness of wall base.
 - 5. Form radius corners for bullnose CMU as follows: The installer shall use a section of 2" diameter plastic pipe to aid in altering the shape of the wall base profile to ease the installation of the material. Simply drape the wall base profile over the pipe with the toe of

the wall base facing up. Heat the wall base along the radius of the pipe with a hot air gun or torch until pliable. While holding the wall base section firmly in contact with the pipe, quench the heated wall base area with a water dampened cloth until the wall base is cool. (This process only takes a few seconds to perform). The wall base will maintain the shape of the pipe when removed. Cut the wall base to the desired length of the return and install with cove base adhesive. Use contact bond adhesive for extremely short returns. Roll with a 2" hand roller to ensure proper adhesion.

- D. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.
- E. Fill all rubber stair tread nosings with epoxy approved by the stair tread manufacturer to prevent any flexing of the tread's nosing. Provide cove stick flash base at all one piece tread riser locations.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing installation:
 - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash until after time period recommended by manufacturer.
 - 4. Damp-mop resilient accessories to remove black marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by manufacturer of resilient product involved.
 - 1. Apply protective floor polish to resilient accessories that are free from soil, visible adhesive, and surface blemishes.
 - a. Use commercially available metal, cross-linked, acrylic product acceptable to resilient accessory manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
- C. Clean products specified in this Section not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products using method recommended by manufacturer.
 - 1. Strip protective floor polish that was applied after completing installation, prior to cleaning.
 - 2. Reapply floor polish after cleaning.

3.05 VINYL WALL BASE PRODUCT DATA SHEET

Vinyl Wall Base Designation: RB1 & RB2

Style: Cove with top-set toe

Minimum Nominal Thickness: 1/8"

Height: 4" (RB1) and 6" (RB2)

Lengths: Coils in lengths standard with manufacturer, but not less than 100 feet

Exterior Corners: Pre-molded or formed on job

Interior Corners: Pre-molded or formed on job

Ends: Pre-molded

Color and Pattern: As selected by Architect/Designer from manufacturer's full range of colors and patterns produced for vinyl wall base complying with requirements indicated. Provide up to two colors.

Available Products:

- 1. Basis of Design: Tarkett "Moon Rock" No. 29 (RB1). Color TBD for (RB2).
- 2. Roppe Corporation
- 3. Flexco Div., Textile Rubber Co.
- 4. Johnsonite

3.06 VINYL ACCESSORY PRODUCT DATA SHEET

Vinyl Accessory Designation: Resilient Edge Strips

Profile and Dimensions: 1/8" thick, homogeneous rubber composition, tapered or bullnose edge.

Color: As selected by Architect/Designer from manufacturer's full range of colors produced for rubber accessories complying with requirements indicated. Provide up to two colors.

END OF SECTION

SECTION 096613 - PORTLAND CEMENT TERRAZZO FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place terrazzo floor and existing floor repair.
- B. Divider strips and termination edging.
- C. Work of this section includes: Patching of cracks and pivots using epoxy filler. Larger areas shall receive matching chips to match existing terrazzo. Submit samples for approval prior to beginning work. The extent of the under slab work is indicated on the drawings for reference only. Field verify all locations and quantities of floor slab repair.

1.02 RELATED REQUIREMENTS

 Section 079200 - Joint Sealants: Sealing joints between terrazzo work and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

- A. ANSI A118.3 American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
- B. ANSI A118.4 American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- C. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- D. ASTM C33/C33M Standard Specification for Concrete Aggregates; 2013.
- E. ASTM C150/C150M Standard Specification for Portland Cement; 2015.
- F. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- G. ASTM D2103 Standard Specification for Polyethylene Film and Sheeting; 2015.
- H. ICRI 310.2R Selecting and Specifying Concrete Surface Preparation; 2013.
- I. NTMA (SPECS) NTMA Terrazzo Specifications; current edition located at www.ntma.com.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for divider strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for the type of terrazzo specified.
- C. Shop Drawings: Indicate divider strip layout and details of adjacent components.
- D. Samples: Submit two samples, 6 by 6 inch in size illustrating color, chip size and variation, chip gradation, mortar color, and typical divider strip.
- E. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, and sealing.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with NTMA recommendations as posted on their web site at www.ntma.com.
- B. Installer Qualifications: Company specializing in performing the work of this section with not fewer than 10 years of documented experience.

1.06 FIELD CONDITIONS

- A. Do not install terrazzo when temperature is below 50 degrees F or above 90 degrees F.
- B. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of terrazzo.
- C. Provide ambient lighting level of 50 ft candles, measured at floor surface.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT TERRAZZO APPLICATIONS

- A. Floors: Monolithic Terrazzo.
 - 1. Color(s): Match Existing
 - 2. Aggregate Type: Match Existing
 - 3. Aggregate Size: Match Existing

2.02 PORTLAND CEMENT TERRAZZO FLOORING

A. Materials:

- 1. Portland Cement: ASTM C150/C150M, Type I Normal; white color for topping mix; modified to NTMA higher compressive strength requirements; obtained from single source.
- 2. Underbed: One part Portland cement to 4 parts sand by volume. Add water to produce low slump mix.
- 3. Color Pigments For Topping: Non-fading mineral type, alkali-resistant.
- 4. Terrazzo Sand: ASTM C33/C33M, fine aggregates.
- 5. Cushion Sand: ASTM C33/C33M, fine aggregates.
- 6. Water: Potable.
- 7. Surface Aggregate: Marble, free of deleterious or foreign matter.

B. Accessories:

- Underbed Welded Wire Reinforcement: ASTM A1064/A1064M; 2 by 2 inch, 18/18 wire, galvanized.
- 2. Divider Strips: To match existing sizes & metal type.
- 3. Control Joint Strips: To match existing sizes & metal type.
- 4. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.
- 5. Cleaner: Neutralizing liquid type, pH of 7 to 10.
- 6. Sealer: Colorless, non-yellowing, penetrating liquid type, pH of 7 to 10; not detrimental to terrazzo components.
- 7. Wood Subfloor Joint Tape: Cloth type.
- 8. Subfloor Filler: Latex type.

2.03 MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I Normal; white color for topping mix; gray color for underbed; modified to NTMA higher compressive strength requirements; obtained from single source.
- B. Color Pigments For Topping: Non-fading mineral type, alkali-resistant.
- C. Terrazzo Sand: 1, fine aggregates.
- D. Cushion Sand: 1, fine aggregates.
- E. Terrazzo Sand: ASTM C33, fine aggregates.
- F. Cushion Sand: ASTM C33, fine aggregates.
- G. Water: Potable.

- H. Surface Aggregate: Crushed marble No. 0 to 1 size in accordance with NTMA chip size for standard gradation and uniform coloration.
- I. Surface Aggregate: Type, color, and size to match existing.
- J. Venetian Surface Aggregate: Crushed marble, in accordance with NTMA chip size for Venetian gradation and uniform coloration.

2.04 ACCESSORIES

- A. Underbed Welded Wire Reinforcement: ASTM A1064/A1064M; 2 by 2 inch, 18/18 wire, galvanized.
- B. Divider Strips: 1/8 inch thick zinc exposed top strip, zinc coated steel concealed bottom strip, with anchoring features.
- C. Control Joint Strips: 1/8 inch nominal width zinc exposed top strips, zinc coated steel concealed bottom strip, 1/8 inch wide neoprene filler strip between vertical strips, with anchoring features. []
- D. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.
- E. Base Cap: Match divider strips.
- F. Foam Filler: Closed cell urethane foam, capable of compression to 50 percent of its thickness with full recovery.
- G. Slip Sheet: ASTM D2103; 4 mil polyethylene sheet.
- H. Slip Sheet: Asphalt treated and reinforced paper.
- I. Curing Compound: ASTM C309.
- J. Cleaner: Neutralizing liquid type, pH of 7 to 10. []
- K. Sealer: Colorless, non-yellowing, penetrating liquid type, pH of 7 to 10; not detrimental to terrazzo components. []

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Do not begin terrazzo work until concrete substrate has cured 28 days, minimum, and has dried to a maximum moisture content of 12 percent.
- C. Coordinate placement of terrazzo divider strips with location of mechanical and electrical access covers.

3.02 PREPARATION

- A. Clean substrate of foreign matter.
- B. Remove loose or flaking concrete and repair to form sound, solid substrate.
- C. Prepare concrete surfaces according to ICRI 310.2R[]
- D. Remove surface water and thoroughly brush in neat cement slurry bond coat.
- E. Prepare wood subfloor, tape joints, and apply subfloor filler. Isolate terrazzo installation from wood subfloor with slip sheet, lapping edges and ends.

3.03 APPLICATION - MONOLITHIC TERRAZZO

- A. Saw cut existing floor slab to receive divider and control joint strips and inserts and fill with grout.
- B. Install strips straight and level to locations indicated.
- C. Install non-slip inserts in floors where indicated.
- D. Install recessed floor mat frames.
- E. Slope strips to match floor surface slope to drains.
- F. Install base divider and control joint strips to match floor pattern.
- G. Install terminating cap strip at top of base; attach securely to wall substrate.
- H. Place terrazzo topping mix over slurry coated substrate to a nominal thickness of 1/2 inch.

3.04 APPLICATION - CAST-IN-PLACE BASE

- A. Vertical Base Flush With Wall: Match existing profile and metal type.
- B. Vertical Base Projecting From Wall: Match existing profile and metal type.

3.05 CURING

- Begin curing procedures as soon as curing materials can be applied without damaging formed surfaces.
- B. Cure terrazzo topping 7 days by the liquid membrane curing method.
- C. Use curing method in accordance with NTMA instructions.
- D. Close area to construction traffic, allowing undisturbed curing.

3.06 SURFACE FINISHING

- A. Brush apply terrazzo topping mix slurry to topping surface.
- B. Finish terrazzo in accordance with NTMA instructions.
- C. Produce terrazzo finish surface with minimum 70 percent chip exposed.
- D. Grind terrazzo surface with power disc machine; successively sequence using coarse to fine grit abrasive, using a wet method.
- E. Apply grout mix matching matrix color to fill honeycomb exposed during grinding.
- F. After grout has sufficiently cured, grind repaired areas using a fine grit abrasive.
- G. Hand grind base.

3.07 TOLERANCES

- A. Maximum Variation from Flat Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch.

3.08 CLEANING

- A. Scrub and clean terrazzo surfaces with cleaner in accordance with NTMA instructions. Let dry.
- B. Immediately after terrazzo has dried, apply sealer in accordance with NTMA instructions and let dry.
- C. Seal and polish surfaces in accordance with NTMA instructions.

3.09 PROTECTION

A. Do not permit construction traffic over finished terrazzo surfaces. **END OF SECTION**

SECTION 096813 - CARPET TILE

PART 1-GENERAL

1.01 SECTION INCLUDES

- A. This Section includes modular track off tile (CPT1).
- B. Note: Where carpeting abut terrazzo flooring the resilient and carpet installer shall provide a feathered underlayment to provide a smooth transition area. The area of floor level transition shall occur over a minimum of three feet distance.

1.02 RELATED REQUIREMENTS

- A. Section 013000 Administrative Requirements Submittal procedures.
- B. Section 090050 Finish Legend
- C. Section 096513 Resilient Wall Base and Accessories, for resilient wall base and accessories installed with carpet tile

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles
 - 2. Carpet tile type, color, and dye lot
 - 3. Pattern of installation
 - 4. Pattern type, location, and direction
 - 5. Pile direction
 - 6. Type, color, and location of edge, transition, and other accessory strips
 - 7. Transition details to other flooring materials

- C. Samples: For each of the following products and for each color and texture required, label each sample with manufacturer's name, material description, color, pattern, and designation indicated on drawings and in schedules.
 - 1. Carpet Tile: Full-size sample
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long samples.
- D. Product Schedule: For carpet tile, use same designations indicated on drawings.
- E. Qualification Data: Installer must be CFI Certified (C-2 level or higher).
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals, include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile
- H. Warranty: Special warranty specified in this section.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 4, "Storage and Handling."

1.07 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Ambient Temperature and Humidity Suitable Substrates" and Section 7.3, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. When warranties are required, verify with Owner's counsel that special warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Division 1 Section "Product Requirements."
- B. Revise paragraph and subparagraphs below if manufacturers have separate warranties for various characteristics.
- C. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

- 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
- 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, and delamination.
- 3. Warranty Period: 10 years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equivalent to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m)

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Shaw Commercial
- B. Available Manufacturers: Other manufacturers proposed which meet the specific standards specified, shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.02 CARPET TILE

- A. Products: Subject to compliance with requirements, provide one of the following Basis of Design selections:
 - 1. Carpet Tile-Walk Off (CPT1)
 - a. MFR: Shaw
 - b. Collection: All Access
 - c. Style: Pace Tile
 - d. Style Number: ST413
 - e. Color: TBD
 - f. Size: 24" x 24"
 - g. Fiber: Eco Solution Q Nylon
 - h. Dye MEthod: 100% Solution Dyed
 - i. Primary Backing: Synthetic
 - j. Secondary Backing: Ecoworx Tile
 - k. Protective Treatments: SSP Shaw Soil Protection
 - 1. Tufted Weight: 28 oz/yd²
 - m. Installation: Monolithic
 - n. Location: In existing recesses in vestibule v200 and Stair St., Field verify recess

2.03 CARPET TILE ADDITIONAL REQUIREMENTS

- A. Applied Soil-Resistance Treatment: Manufacturer's standard material
- B. Antimicrobial Treatment: Manufacturer's standard material
- C. Performance Characteristics: As follows:
 - 1. Colorfastness to Light:
- D. Flammability, Methenamine Pill Test (DOC FF-1-70): Passes
- E. Flooring Radiant Panel (ASTM E-648): Class 1
- F. Smoke Density (ASTM E-662): Less than 450

- G. Wearability: Lifetime Commercial Wear Warranty
- H. Edge Ravel/Zippering: Lifetime Warranties
- I. Backing Integrity/Delamination: Lifetime Warranties
- J. Traffic Class: Heavy
- K. CRI Green Label:
- L. ADA Compliance: This product meets the guidelines as set forth in the Americans with Disabilities Act for minimum static coefficient of friction of 0.6 for accessible routes.

2.04 ACCESSORIES

- A. Carpet Edge Guard: Extruded aluminum carpet bar model No. MT-00-A as manufactured by Johnsonite (or approved equivalent). Extruded T-Moulding cap strip profile specifically made to transition between materials as manufactured by Johnsonite (or approved equivalent).
 - 1. Manufacturers: Subject to compliance to specifications, provide products as manufactured by one of the following:
 - a. Futura Home Products
 - b. William L. Bonnell Co., Inc.
 - c. Macklanburg Duncan
 - d. Mercer Products Co., Inc.
 - e. Flexco Division, Textile Rubber Co.
 - f. Roppe
 - g. Johnsonite, Inc.
- B. Carpet Adhesive: Water resistant and non-staining as recommended by carpet manufacturer to comply with flammability requirements for installed carpet.

2.05 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Pressure Sensitive Adhesive System. CRI Green Label Plus certified and recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with CRI 104, Section 7.0 "Site Conditions" and to Section 8.0 "Substrate Preparation" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

- A. General: Comply with CRI 104, Section 10 "Carpet Tile" and with carpet tile manufacturer's written installation instructions.
- B. Installation method, layout: Monolithic.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 11, "Post Installation".
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 096813.01 - CARPET TILE INSTALLER'S CERTIFICATION PART 1 GENERAL

1.01 CARPET TILE INSTALLER'S CERTIFICATION

| | itted as outlined in the Supplemental Instructions to fication may be cause for rejection of the bidder's |
|---|---|
| Date Submitted: | |
| Name & Address of Carpet Tile Installer: | |
| | |
| I certify that Certification for carpet installation. | (Name of Carpet Tile Installer) has achieved CFI |
| CFI Number | |
| Signed: | Title: |

END OF SECTION

SECTION 097800 - STAINLESS STEEL WALL PANELS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes stainless steel wall lining in food preparation areas, at ovens and where indicated on the drawings.

1.03 PROJECT CONDITIONS

- A. Field Measurements:
 - 1. Verify wall dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the work, establish required dimensions and coordinate fabrication to ensure that actual dimensions correspond to established dimensions.

1.04 COORDINATION

A. Coordinate equipment layout and installation with other work, including light fixtures, HVAC equipment, and fire-suppression system components.

PART 2 PRODUCTS

2.01 WALL PANEL MATERIALS

- A. Stainless Steel Sheet: Use 18 gauge (0.025") ASTM A 666, Type 304 stainless steel sheets.
 - 1. General: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
 - 2. Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. run grain with long dimension of each piece.
 - 3. Stainless Steel Finishes:
 - a. Exposed Surfaces: ASTM A 480/A 480M, No. 4 finish-Satin Finish.
 - b. Concealed Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished finish).
 - 4. STST 1-Basis of Design: INPRO
 - a. Product: Stainless Steel Wall Panels and Trim
 - b. Height: Full height, 4' x 10'. Sheets cut to fit
 - c. STST Trims: Outside corners, top caps, divider trims and inside corners
 - d. Location: Kitchen BOH, Refer to Plans.
- B. Fabricate the following wall panel joint connectors and covers using matching material:
 - 1. Panel corner, center, and end split joints, cleats and moldings.
 - 2. Top, bottom, and end panel edge covers and flashings.
 - 3. Formed and matching end trim.

2.02 SEALANT AND ADHESIVE MATERIALS

- A. Adhesive: Use Single-Component Acid-Curing Silicone Sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT. Use a product that meets the following criteria:
 - 1. Adhesive shall be NSF certified for commercial kitchen applications.
 - 2. When cured and washed, adhesive shall comply with the requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.

- 3. Be tested and listed as suitable for food contact applications for repeated use under FDA Regulation 21 CFR 175.105 "Adhesives" and 175.300 "Resinous and Polymeric Coatings."
 - a. Color: Grey or aluminum color, as approved by Architect.
 - b. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- 4. Available products include, but are not limited to, the following:
 - a. GE Silicones: Contractors SCS1000 Series "Silicone Adhesive Sealant."
 - b. Sonneborn, Division of ChemRex, Inc.: OmniPlus.
 - c. Tremco: Proglaze.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present for compliance with requirements for installation tolerances and other conditions affecting installation.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Verify wall backing panels described in Section 092116 "Gypsum Board Assemblies" are in place and secure.
- D. Detail and fabricate according to details shown for food service areas in SMACNA's Kitchen Equipment Manual, and according to standards required for NSF certification.

3.02 INSTALLATION

- A. Install full height, from top of coved flooring base to close at exhaust hoods.
- B. Make cutouts in wall panels where required to accommodate pipe penetrations, service lines and to make final connections.
- C. Securely anchor and attach items and accessories to walls, floors, or bases with stainless steel fasteners, unless otherwise indicated.
- D. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless steel fasteners at 48 inches o.c. maximum.
- E. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide watertight, vermin-proof, sanitary joints.

3.03 CLEANING

A. Remove soiling, paint splatters and other spots, dirt and debris. Repair damaged finish to match original finish.

END OF SECTION

SECTION 099000 - PAINTING

PART 1-GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 RELATED REQUIREMENTS

- A. Section 015721 Indoor Air Quality Management
- B. Section 055000 Metal Fabrications: Shop-primed items
- C. Section 055100 Metal Stairs: Shop-primed items
- D. Section 090050 Finish Legend
- E. Section 101100 Visual Display Surfaces
- F. Section 220553 Identification for Plumbing Piping and Equipment: Painted identification
- G. Section 260553 Identification for Electrical Systems: Painted identification
- H. Section 321723.13: Pavement markings

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency
- B. ASTM D 16 Standard Terminology for Paint, Related Coatings, Materials, and Applications
- ASTM D 4442 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials
- D. GreenSeal GS-11 Paints

1.04 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surface preparation and primer.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. VOC data: Submit Green Seal GS-11 and/or GC-03 compliance documents and description of the basis for compliance.
- C. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.
- D. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
 - 2. All exposed to view (from the ground) flashing are to be furnished prefinished where available. If items are not available prefinished, they are to be painted. Coordinate with Contractor on these items.
 - 3. Exposed copper piping shall receive a painting system.

- 4. It shall be the full responsibility of the painter to verify all paint, types to determine if paint(s) system specified are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by painter/manufacturer based on testing and field experience. All existing painted surfaces shall be tested to ensure product compatibility and to ensure that the paint bonds will not fail.
- 5. Painting shall include field painting pre-finished grilles, registers and diffusers located on gypsum board ceilings and soffits, which are to receive an accent paint color.
- 6. Painting shall include field painting exposed unfinished countertop and shelving brackets.
- 7. Exterior items to receive a painting system include but are not limited to the following:
 - a. Site railing
 - b. Steel structure
 - c. Metal decking
 - d. Guardrails
 - e. Concrete Foundation Walls
- 8. Where the Room Finish Schedule calls for a new paint system (P#), new painting shall include all previously painted items including but not limited to door and window frames, doors, conduit, HVAC components, etc.
- 9. Work of this section includes preparing, priming and painting the exterior concrete retaining walls. Remove all foreign substances and properly prepare the surface to receive a complete paint system.
- E. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork
 - b. Elevator entrance doors and frames
 - c. Elevator equipment
 - d. Finished mechanical and electrical equipment
 - e. Light fixtures
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas
 - b. Ceiling plenums
 - c. Pipe spaces
 - d. Duct shafts
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum
 - b. Stainless steel
 - c. Chromium plate
 - d. Bronze and brass
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators
 - b. Linkages
 - c. Sensing devices
 - d. Motor and fan shafts
 - 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.05 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.

- 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
- 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.06 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
- C. Manufacturer's Instructions: Indicate special surface preparation procedures.
- D. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- E. VOC Content: Determine VOC (Volatile Organic Compound) content of solvent borne and waterborne paints and related coatings in accordance with EPA Method 24 or ASTM D3960.
- F. Product Data: For each paint system indicated. Include primers.
 - 1. When proposing another manufacturers product other than product specified, a complete cross-reference list must be included with the submittal. Shop drawings will be automatically returned if the list is not included.
 - 2. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 3. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- G. Samples for Initial Selection: For each type of finish-coat material indicated.
 - 1. After color selection, Architect will furnish color chips for surfaces to be coated.
 - 2. The painter is required to submit drawdowns of each paint color for review of color and sheen match.

1.07 OUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material
 - 2. Product description (generic classification or binder type)
 - 3. Manufacturer's stock number and date of manufacture
 - 4. Contents by volume, for pigment and vehicle constituents
 - 5. Thinning instructions
 - 6. Application instructions
 - 7. Color name and number
 - 8. VOC content

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.09 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).
- B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
- C. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.10 EXTRA MATERIALS

- A. See Section 016000 Product Requirements, for additional provisions.
- B. Supply 1 gallon of each color; store where directed.
- C. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles or approved equivalent as manufactured by one of the following manufacturers.
- C. Paint Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. ICI Paints & Devoe High Performance Coatings (ICI)
 - 2. Sherwin-Williams Co. (Sherwin-Williams)
 - 3. Coronado Paint Company (Coronado)
 - 4. PPG Paints, Inc. (Pittsburgh & Porter Paints)
 - 5. Farrell Calhoun Paint
- D. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements.
 - 1. Interior paint: Comply with GS-11
 - 2. Exterior paint: Comply with GS-11

2.02 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.03 PAINTS AND COATINGS - GENERAL

- A. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Paints and coatings applied on site shall comply with the following VOC content limits:
 - 1. Interior paint: Comply with GS-11
 - 2. Exterior paint: Comply with GS-11
 - 3. Flat: 50 g/L
 - 4. Non-flat: 150 g/L
 - 5. Anti-corrosive & anti-rust: 250 g/L
- B. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- C. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- D. Chemical Content: The following compounds are prohibited:
 - 1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings)
 - 2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride

2.04 PAINT SYSTEMS - EXTERIOR

- A. Exterior Primers:
 - 1. Exterior Concrete and Masonry Primer: Factory formulated alkali resistant acrylic latex primer for exterior application
 - Sherwin-Williams Loxon Concrete & Masonry Primer LX02W0050 VOC 99 g/l 3.2
 mils. DFT
 - b. PPG Industries Perma-Crete Int/Ext Alkalie Resistant Primer 4-603VOC< 100 g/l
 - c. Benjamin Moore & Co. Products
 - 1) Concrete and Masonry, N068 Super Spec Masonry High Build Primer
 - 2. Exterior Ferrous Metal Primer: Factory formulated rust inhibitive metal primer for exterior application.
 - a. Sherwin-Williams Pro-Industrial Pro-Cryl Universal acrylic primer B66-310 series VOC less than 100 g/l 2.0-4.0 mils. DFT
 - b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC <100 g/l
 - c. Benjamin Moore & Co. Products

- 1) Ferrous Metal, P06 Alkvd Metal Primer
- 3. Exterior Galvanized Metal Primer: Factory formulated galvanized metal primer for exterior application.
 - a. Sherwin-Williams Pro-Industrial Pro-Cryl Universal acrylic Primer B66-310 series VOC less than 100 g/l 2.0-4.0 mils DFT
 - b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC <100 g/l
 - c. Benjamin Moore & Co. Products
 - 1) Galvanized Metal, P04 Acrylic Metal Primer
- 4. Exterior Wood Primer: Factory formulated wood primer for exterior application.
 - a. Sherwin-Williams Loxon Concrete & Masonry Primer/Sealer, LX02W0050

B. Exterior Finish Coats:

- 1. Exterior Semigloss Acrylic Enamel: Factory formulated semigloss waterborne acrylic_latex enamel for exterior application.
 - Sherwin-Williams Exterior Super Paint Latex Satin A89 Series VOC 114 g/l 1.44 mils DFT
 - b. PPG Industries Speedhide Exterior 100% Acrylic Semi-Gloss 6-900XI series VOC < 50 g/l
 - c. Exterior Semigloss Acrylic Semigloss, N449 Ultra Spec Exterior Gloss Finish
 - d. Benjamin Moore & Co. Products
 - 1) Exterior Semigloss Acrylic Semigloss, N449 Ultra Spec Exterior Gloss Finish
- C. Exterior Finish Coats Metal: Factory formulated water based alkyd urethane enamel:
 - 1. Sherwin Williams; Pro-Industrial, number B53-1050 series, gloss (B53-1150 semi-gloss, B53-1250 low sheen) VOC 50 g/l <0.42 lb/gal, wet mils 4.0 5.0, dry mils 1.4 1.7
 - 2. PPG Industries Speedhide Exterior 100% Acrylic Semi-Gloss 6-900XI series VOC < 50 g/l

2.05 PAINT SYSTEMS - INTERIOR

- A. Special Conditions:
 - 1. Mold on basement walls occur in vestibule V100, Lobby L100, and Janitor closet 116. Where these conditions exist, the surface shall be cleaned prior to any painting. Small test areas shall be used to determine the effectiveness of the cleaning. Mildew may be removed before painting by washing with a solution of 1 part liquid bleach and 3 parts water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with water and allow the surface to dry before painting. Wear protective eyewear, waterproof gloves, and protective clothing. Quickly wash off any of the misture that comes in contact with your skin. Do not add detergents or ammonia to the bleach /water solution.
 - 2. After the surfaces are clean and dry, apply a primer and top coats as required.
 - a. Interior Concrete Primer: Equal to Sherwin Williams ConFlex Block Filler
 - b. Interior Gypsum Board PRimer: Sherwin Williams ProMar 200 Zero VOC Latex Primer B28W2600 VOC 2 G/L 1.5 DFT
 - 3. Top Coats: Sherwin Williams Super Paint Air Purifying Technology Interior Acrylic Satin A87-61-A87-63. Provide two coats minimum.

B. Interior Primers:

- 1. Interior Concrete Primer: Factory formulated alkali resistant acrylic latex interior primer for interior application
 - a. Sherwin-Williams PrepRite Block Filler B25W25 VOC 42 g/l 8.0 mils. DFT
 - b. PPG Industries Speedhide Int/Ext Hi Fill Block Filler 6-15 VOC < 50 g/l
 - c. Benjamin Moore & Co. Products
 - 1) Interior Concrete Primer, N068 Super Spec Masonry High Build Primer

- 2. Interior Gypsum Board Primer: Factory formulated latex based primer for interior application
 - a. Sherwin-Williams Promar 200 Zero VOC Latex Primer B28W2600 VOC 2 G/L 1.5 DFT
 - b. PPG Industries Speedhide Zero Latex Primer 6-4900 Zero VOC
 - c. Benjamin Moore & Co. Products
 - 1) Interior Gypsum Board Primer, N534 Ultra Spec 500 Interior Primer
- 3. Interior Wood Primer for acrylic enamel and semigloss alkyd enamel finishes: Factory formulated alkyd or acrylic latex based interior wood primer
 - a. Sherwin-Williams Multi-Purpose Latex Primer B51W8020 VOC 96 G/L 1.4 mils DFT
 - b. PPG Industries Seal-Grip Int/Ext Universal Acrylic Primer 17-921XI VOC > 100 g/l
 - c. Benjamin Moore & Co. Products
 - 1) Interior Wood Primer, 023 Fresh Start All Purpose Primer
- 4. Interior Ferrous Metal Primer: Factory formulated quick drying rust inhibitive alkyd based metal primer
 - a. Sherwin-Williams Pro-Industrial Pro-Cryl Universal acrylic Primer B66-310 series VOC 110 g/l 2.0-4.0 mils DFT
 - b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC < 100 g/l
 - c. Benjamin Moore & Co. Products
 -) Interior Ferrous Metal Primer, P06 Alkyd Metal Primer
- 5. Interior zinc-coated metal primer: Factory formulated galvanized metal primer
 - a. Sherwin-Williams Pro-Cryl Universal Water Based Primer B66-310 Series VOC 110 g/l 2.0-4.0 mils DFT
 - b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC < 100 g/l
 - c. Benjamin Moore & Co. Products
 - 1) Interior Zinc-Coated Metal Primer, P04 Acrylic Metal Primer

C. Interior Finish Coats:

- 1. Interior Finish Coats Stair And Ramp Railings: Factory formulated high solids, single pack acrylic polysiloxane:
 - a. PPG Industries PSX One High Solids, high gloss. Two (2) coats are required to act as a self-primer.
 - b. Sherwin Williams Sher-Loxane 800, B58W00501. VOC < 100 g/l wet mils 5.0 7.0, dry mils 4.0 6.0. Two (2) coats are required to act as a self-primer.
- 2. Interior Finish Coats Metal Excluding Stair and Ramp Railings: Factory formulated water based alkyd urethane enamel:
 - a. Sherwin Williams; Pro-Industrial, number B53-1050 series, gloss (B53-1150 semi-gloss, B53-1250 low sheen) VOC 50 g/l <0.42 lb/gal, wet mils 4.0 5.0, dry mils 1.4 1.7
 - b. Benjamin Moore & Co. 79301 Advance waterborne interior alkyd semi-gloss
 - e. PPG Industries 1506-0110 Lifemaster Oil interior/exterior semi-gloss
- 3. Interior Flat Acrylic Paint: Factory formulated flat acrylic emulsion latex paint for interior application
 - Sherwin-Williams Promar 200 Zero VOC Interior Latex Flat B30W2651 VOC 2
 G/L 1.6 DFT
 - b. PPG Industries Speedhide Zero Interior Latex Flat 6-4110 series Zero VOC
 - c. Benjamin Moore & Co. Products
 - 1) Interior Flat Acrylic, N536 Ultra Spec 500 Interior Flat
- 4. Interior Semigloss Acrylic Enamel: Factory formulated semigloss acrylic latex enamel for interior application

- a. Sherwin-Williams Promar 200 Zero VOC Interior Latex Semi-gloss B31W2600 Series 0 g/l 1.6 mils DFT. If using above product for trim areas, this is the more durable product.
- b. PPG Industries Speedhide Zero Interior Latex Semi-Gloss 6-4510 series Zero VOC
- e. Benjamin Moore & Co. Products
 - 1) Interior Semigloss Acrylic Enamel, N539 Ultra Spec 500 Interior Semigloss
- 5. Interior Eggshell Acrylic Paint: Factory formulated eggshell acrylic latex paint for interior application:
 - a. Sherwin Williams Promar 200 Zero VOC Interior Latex Eggshell B20W2600 applied as a dry film thickness
 - b. PPG Industries Speedhide Zero Interior Latex Eggshell 6-4310 series Zero VOC
 - c. Benjamin Moore & Co. Products
 - 1) Interior Eggshell Acrylic Paint, N538 Ultra Spec 500 Interior Eggshell
- 6. Interior Gloss Acrylic Paint: Factory formulated gloss acrylic latex paint for interior application:
 - a. Sherwin Williams Promar 200 Interior Latex Gloss B21W2250 Series VOC 2 G/L applied as a dry film thickness of 1.7 mils
 - b. PPG Industries Speedhide Int/Ext 100% Acrylic Gloss 6-8534 series VOC <100 g/l
 - c. Benjamin Moore & Co. Products
 - 1) Interior Gloss Acrylic Paint, N540 Ultra Spec 500 Interior Gloss
- 7. Interior Chalk Board Paint (P7):
 - a. Sherwin Williams Krylon Chalkboard Paint.
- D. All walls, Gypsum board ceilings, metal deck, structural elements, conduit, all unfinished surfaces exposed after construction is complete shall receive a paint system unless noted otherwise.
- E. All unfinished exterior surfaces including concrete block, steel lintels, etc. will receive a paint system. Refer to the specifications for additional information.

2.06 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler
- C. Fastener Head Cover Material: Latex filler

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, conform to procedures applicable when hazardous or contaminated materials are discovered.
- B. Substrate: Install formaldehyde-free MDF, particle board, or straw particle board.
- C. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

- D. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
- E. Indoor Air Quality: Provide temporary ventilation during work of this section.
- F. Waste Management: As specified in Section 01351 Waste Management and as follows:
 - 1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. Close and seal all partially used containers of paint to maintain quality as necessary for reuse.

3.02 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - 2. Required Surface Preparation:
 - a. Step 1 Dust wall and other surfaces to receive paint by working down with a dust mop, static duster, or feather duster.
 - b. Step 2 Clean surface with a mild detergent using a sponge or soft cloth.

 Avoid using cleaners containing alcohol on latex paint, as alcohol can dissolve and damage the paint film.
 - c. Step 3 Wash surfaces from the bottom up to avoid water running down the wall over the dirt.
 - d. Step 4 Rinse out the sponge in clean water until the cleaning solution is removed. Use the cleaned sponge to thoroughly rinse the washed area.
 Residual cleaner will interfere with adhesion of paint applied subsequently.
 - e. Step 5 Use a soft cloth or towel to blot excess water off the paint film.
 - f. Refer to Item C below for additional requirements.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

- 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery. Revise first subparagraph and associated subparagraphs below to suit Project.
- 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - Touch up bare areas and shop-applied prime coats that have been damaged.
 Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

- A. Paint Strippers: Compounds that do not contain methylene chloride tend to be slower-acting than conventional paint strippers and may take from one hour to overnight to work. Comply with manufacturer's recommendations for application.
- B. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

- 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
- 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
- 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
- 9. Sand lightly between each succeeding enamel or varnish coat.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- E. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- G. Mechanical items to be painted include, but are not limited to, the following:
 - 1. Uninsulated metal piping.
 - 2. Uninsulated plastic piping.
 - 3. Pipe hangers and supports.
 - Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - 5. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 - 6. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- H. Electrical items to be painted include, but are not limited to, the following: List below contains electrical items that are usually field painted. Add other items to suit Project.
 - 1. Switchgear.
 - 2. Panelboards.

- 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Section 220553 and Section 260553 for schedule of color coding of equipment, duct work, piping, and conduit.
- B. Paint shop-primed equipment, where indicated.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Finish equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.05 INDOOR AIR QUALITY

- A. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.
- B. Maximize ventilation during application and drying.
- C. Isolate area of application from rest of building.
- D. Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms.

3.06 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.07 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.08 EXTERIOR PAINT SCHEDULE

- A. Concrete Unit Masonry: Provide the following finish systems over exterior concrete unit masonry:
 - 1. Semigloss Alkyd Urethane Finish: Two finish coats over a block filler
 - a. Block Filler: Concrete unit masonry block filler
 - b. Finish Coats (Minimum Two): Exterior semigloss alkyd urethane
- B. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Semigloss Alkyd Urethane Finish: Two finish coats over a rust-inhibitive primer
 - a. Primer: Exterior ferrous-metal primer
 - b. Finish Coats (Minimum Two): Exterior semigloss alkyd urethane
- C. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 - 1. Semigloss Alkyd Urethane Finish: Two finish coats over a galvanized metal primer
 - a. Primer: Exterior galvanized metal primer
 - b. Finish Coats (Minimum Two): Exterior semigloss alkyd urethane

3.09 INTERIOR PAINT SCHEDULE

- A. Concrete: Provide the following finish systems over interior concrete masonry:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer
 - a. Primer: Interior CMU Primer
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel
- B. Gypsum Board Ceilings & Soffits: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Flat Acrylic Finish: Two finish coats over a primer
 - a. Primer: Interior gypsum board primer
 - b. Finish Coats (Minimum Two): Interior flat acrylic paint
- C. Gypsum Board (Walls): Provide the following finish systems over interior gypsum board surfaces:
 - 1. Finish: Two finish coats.
 - a. Primer: Interior gypsum board primer
 - b. Finish Coats (Minimum Two): Interior Egg Shell Enamel
- D. Wood and Hardboard: Provide the following paint finish systems over new interior wood surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a wood undercoater
 - a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel
- E. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer
 - a. Primer: Interior ferrous-metal primer
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel
- F. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer
 - a. Primer: Interior zinc-coated metal primer
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel

3.10 WASTE MANAGEMENT

A. Separate waste in accordance with the Waste Management Plan. Set aside extra paint for future color matches, or reuse by Owner. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility.

- B. Close and tightly seal all partly used paint and finish containers and store protected in well-ventilated, fire-safe area at moderate temperature.
- C. Place empty containers of solvent-based paints in areas designated for hazardous materials.
- D. Do not dispose of paints or solvents by pouring on the ground. Place in designated containers for proper disposal.

END OF SECTION

SECTION 101101 - VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 090050 Finish Legend.

1.02 SUMMARY

- A. This Section includes the following types of visual display boards:
 - 1. Porcelain enamel markerboards (for liquid chalk) with rare earth magnets
- B. Display board installation will utilize "Z" or "L" clip mounting bars top and mounting angles bottom only. Adhesives used for mounting display boards will not be acceptable.
- C. Where visual display boards are too wide for the location indicated, the supplier shall notify the designer and modify the width accordingly.
- D. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 6 Section "Miscellaneous Carpentry" for wood blocking and grounds

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Include manufacturer's data substantiating that products comply with requirements indicated.
- C. Shop Drawings: Provide shop drawings for each type of markerboard, and tackboard required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
- D. Samples: Provide the following samples of each product for initial selection of colors, patterns, and textures, as required, and for verification of compliance with requirements indicated.
 - 1. Samples for initial selection of color and pattern
 - a. Porcelain Enamel Markerboard: Manufacturer's color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of markerboard required
- E. Certificates: In lieu of laboratory test reports, when permitted by the Designer/Architect, submit the manufacturer's certification that vinyl-fabric-faced cork tackboard materials furnished comply with requirements specified for flame spread ratings.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Furnish all markerboards, tackboards and tackstrips from a single manufacturer for the entire project.
- B. Fire Performance Characteristics: Provide vinyl-fabric-faced tackboards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
 - 1. Flame Spread: 25 or less
 - 2. Smoke Developed: 10 or less
- C. Design Criteria: The drawings indicate sizes, profiles, and dimensional requirements of visual display boards. Other visual display boards having equivalent performance characteristics with deviations

from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof of equality is on the proposer.

1.05 WARRANTY

A. Porcelain Enamel Markerboard Warranty: Furnish the manufacturer's written warranty, agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking, provided the manufacturer's instructions with regard to handling, installation, protection, and maintenance have been followed.

1. Warranty Period: 50 years

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Visual Display Board Manufacturer: Subject to compliance with requirements, provide products including, but are not limited to one of the following:
 - 1. Porcelain Enamel Markerboards:
 - a. Basis of Design: Claridge Concept Dry Erase Markerboard with LGS3 porcelain with sleek narrow trim. Provide one set rare earth magnets.
 - b. American Visual Display
 - c. Best-Rite Chalkboard Company
 - d. Ghent Manufacturing
 - e. Marsh Company
 - f. Platinum Visual Systems
 - g. Polyvision

2.02 MATERIALS

- A. Porcelain Enamel Markerboards; Basis of Design: Claridge: Concept Dry Erase Markerboard: Provide balanced, high-pressure-laminated porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.
 - 1. Face Sheet: Provide face sheet of 24-gage enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat the exposed face and exposed edges with a 3-coat process consisting of primer, ground coat, and color cover coat, and the concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at the manufacturer's standard firing temperatures, but not less than 1200 deg F (649 deg C).
 - 2. Markerboard Cover Coat: Provide the manufacturer's standard light-colored special writing surface with gloss finish intended for use with liquid felt-tipped markers.
 - a. Color shall be as selected by Designer/ Architect from full range of standard colors.
 - 3. Core: Provide the manufacturer's standard 3/8-inch-thick particleboard core material complying with the requirements of ANSI A208.1, Grade 1-M-1.
 - 4. Backing Sheet: Provide the manufacturer's standard 0.015-inch-thick aluminum sheet backing.
 - 5. Laminating Adhesive: Provide the manufacturer's standard moisture-resistant thermoplastic-type adhesive.

2.03 FABRICATION

- A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
- B. Assembly: Provide factory-assembled markerboard and tackboard units, except where field-assembled units are required.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Designer/Architect.

- Provide the manufacturer's standard vertical joint system between abutting sections of markerboard.
- 3. Provide manufacturer's standard mullion trim at joints between markerboard and tackboard.

2.04 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II Clear Anodized Finish: AA-M12C22A31 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

PART 3 EXECUTION

3.01 PREPARATION

A. Field Measurements: Take field measurements prior to the preparation of shop drawings and fabrication where possible, to ensure proper fitting of the work. Allow for trimming and fitting wherever taking of field measurements before fabrications might delay work.

3.02 INSTALLATION

- A. Deliver factory-built markerboard and tackboard units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Designer/Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
- B. Installer must examine the areas and conditions under which units are to be installed and notify the Designer/Architect in writing of conditions detrimental to the proper timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- C. Markerboards and tackboards shall be installed in strict accordance with manufacturer's recommendations, using concealed hangers at the top and wall angle at the bottom. Installation shall not require grounds.
- D. Provide blocking pads behind all boards at 16" o.c.
- E. Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb and level. Provide all grounds, clips, backing materials, brackets, anchors, trim and accessories necessary for a complete installation.
- F. Boards shall not be installed until the walls have been painted. Any damage to the painted walls shall be corrected.

3.03 ADJUST AND CLEAN

- A. Verify that accessories required for each unit have been properly installed and that operating units function properly.
- B. Clean units in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 101424 - SIGNS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 9 Section 090050 Finish Legend

1.02 SUMMARY

- A. This Section includes the furnishing of Specialty Signs. Extent of Specialty Signs is shown on the Drawings and in this section.
- B. Forms of Specialty Signs required include the following:
 - 1. Custom stand-off signage with custom P/N. -Sign Type 1
 - 2. Custom stand-off signage-sign type 2
 - 3. Custom stand-off signage-sign type 3
 - 4. Custom stand-off signage (directional) sign type 4
 - 5. Custom stand-off signage-sign type 5
 - 6. Laser Cut Acrylic Letters
 - 7. Vinyl film-Refer to Alternate #3
 - 8. Donor Recognition Wall
- C. Work not included in this section:
 - 1. Illuminated exit signs are specified in Division 16.
 - 2. Handicapped parking signs are specified in Division 10 Exterior Post & Panel Signs.
 - 3. Exterior post and panel signs are specified in Division 10 Exterior Post and Panel Signs.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and layout of lettering.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
 - 3. Furnish full-size spacing templates for individually mounted letters, numbers and graphics.
 - 4. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
 - a. Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated:
 - 1) Panel Sign Cast Acrylic Sheet and Plastic Laminate: Provide a sample panel not less than 8-1/2 inches by 11 inches for each material indicated. Include a panel for each color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.

1.04 QUALITY ASSURANCE

- A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
- B. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.
- C. ADA Regulations: All signage specified herein shall comply with the minimum sign requirements as outlined by the most current Americans with Disabilities Act (ADA).
 - Manufacturer shall be responsible for complying with all applicable requirements of ADA
 whether specifically specified or not. Notify Architect of any discrepancies between ADA
 requirements and the contract documents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Manufacturers of Interior Custom Stand-off Signs:
 - a. Appenx Architectural Signage
 - b. APCO Architectural Sign Systems
 - c. ASI Modulex
 - d. Best Manufacturing Co.
 - e. Contemporary Plastics, Inc.
 - f. Fastsigns of Louisville
 - g. Innerface Sign System
 - h. Inpro
 - i. J. Gemini, Inc.
 - j. Mohawk Signs
 - k. Nelson-Harkins
 - 1. Serigraphics Sign Systems, Inc.
 - m. Signcraft
 - 2. Manufacturers of Vinyl Window Lettering:
 - a. Appenx Architectural Signage
 - b. APCO Architectural Sign Systems
 - c. ASI Modulex
 - d. Best Manufacturing Co.
 - e. Contemporary Plastics, Inc.
 - f. Fastsigns of Louisville
 - g. Innerface Sign System
 - h. Inpro
 - i. J. Gemini, Inc.
 - j. Mohawk Signs
 - k. Nelson-Harkins
 - 1. Serigraphics Sign Systems, Inc.
 - m. Signcraft

2.02 CUSTOM STAND-OFF SIGNAGE

- A. Stand-Off Signs-Sign Type 1
 - 1. Style: Custom Stand-Off Signage
 - 2. Product Number: ECTC-EC 88.1 (Custom P/N) G9120.0808U

Tactile. C0206 U Firsurf . A0508U

SF050. A-SS (Stand-Off) Qty: 4

- 3. Size: 8" High x 8" Wide
- 4. Mount: Wall Mount, Stand-Off
- 5. Plaque Color: U-Ultra Light Grey Frosted
- 6. Copy Style: First Surface Print and 1/16" Surface Applied Tactile/Braille
- 7. Copy Color: White, Pantone 541 Blue & 131 Gold (Logo) Black. (Room Name) BU-Black Umber (Room #)
- 8. Copy Size: 5/8" (Room Name), 3/4" (Room #)
- 9. Copy Position: Centered
- 10. Front: Futura Md BT (Room Name). Hv BT (Room #)
- 11. Artwork File: Q:\Sales To Graphics\Mark\KPCArchitectural Products\ElizabethtownECTC.cdr
- 12. Stand-Off Finish: SS-Stainless Steel
- 13. Stand-Off Size: 1/2" Diameter. 3/4" Tall Barrels. 3/16" Tall Cap
- B. Stand-Off Signs-Sign Type 2
 - 1. Style: Custom Stand-Off Signage
 - 2. Product Number: ECTC-EC 88.1 RR (Custom P/N)

G9120.0808U

Tactile. C0206U

Firsurf. A0508U

SF050.A-SS (Stand-Off) QTY:4

- 3. Size: 8" High x 8" Wide
- 4. Mount: Wall Mount, Stand-Offs
- 5. Plaque Color: U-Ultra Light Grey Frosted
- 6. Copy Style: 1/16" Surface Applied Tactile/Braille
- 7. Copy Color: BU-Black Umber
- 8. Copy Size: 3/4" Text, 2 1/2" and 4" symbols
- 9. Copy Position: Centered
- 10. Font: Futura Hv BT
- 11. Stand-Off Finish: SS-Stainless Steel
- 12. Copy Size: 1/2" Diameter. 3/4" Tall Barrels. 3/16" Tall Cap.
- 13. Provide appropriate RR, Elevator, Stair, etc...symbol
- C. Stand-Off Signs-Sign Type 3
 - 1. Style: To match sign type 2
 - 2. Size: 4" H x 8" W
- D. Stand-Off Signs-Sign Type 4-Directional
 - 1. Style: To match sign type 2
 - 2. Size: 20" High-Max x 18" Wide
 - 3. Copy: To include text, arrows and numbers.
- E. Stand-Off Signs-Sign Type 5-Exit
 - 1. Style: To match sign type 2
 - 2. Size: 8" H x 8" W
 - 3. Provide appropriate stair symbol
 - 4. Copy: "EXIT" and "EXIT STAIR DOWN"

2.03 VINYL FILM

- A. Vinyl Film: Provide vinyl film signage and graphics as manufactured by 3M's films or approved equivalent.
 - 1. Opaque Graphic Films
 - 2. Reflective Graphic Films
 - 3. Size: Refer to Elevation F/A2.1

2.04 DONOR RECOGNITION WALL

- A. Signage-Donor Recognition Wall
 - 1. Refer to 090050 Finish Legend for Donor Wall Information and Sheet A2.3

2.05 FABRICATION - GENERAL

- A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
- B. Design, fabricate, and install sign assemblies to prevent buckling, opening up of joints, and over-stressing of welds and fasteners.
- C. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
- D. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
- E. Create signage to required sizes and layout. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

2.06 FINISHES

A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- B. Wall Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
 - 1. Mounting: Use expansion bolt anchoring device as recommended by manufacturer to attach signs to concrete block walls. Provide minimum 4 fasteners for 8" x 8" signs.
 - 2. Mount interior signs with centerline one foot from latch side of door frames, and top of sign five feet above finish floor. Note: Lower signs as required to meet all ADA requirements.
 - 3. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 3 inches (76 mm) of signage without encountering protruding objects or standing within the swing of a door.
 - 4. Where a tactile sign is provided at a door, the sign shall be alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leaves, the sign shall be to the right of the right-handed door. Where there is no wall space on the latch side of a single door, or to the right side of double doors, signs shall be on the nearest adjacent wall. Signs containing tactile characters shall be located so that a clear floor area 18 inches (455 mm) minimum by 18 inches (455 mm) minimum, centered on the tactile

- characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
- 5. Tactile characters on signs shall be located 48 inches (1220 mm) minimum above the finish floor or ground surface, measured from the baseline of the lowest tactile character and 60 inches (1525 mm) maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.

3.02 CLEANING AND PROTECTION

A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

SECTION 101550 - TOILET COMPARTMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 RELATED REQUIREMENTS

- A. Section 051200 Structural Steel Framing: Concealed steel support members
- B. Section 055000 Metal Fabrications: Concealed steel support members
- C. Section 061000 Rough Carpentry: Blocking and supports
- D. Section 090050 Finish Legend
- E. Section 102800 Toilet, Bath, and Laundry Accessories

1.03 REFERENCE STANDARDS

 A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015

1.04 ADMINISTRATIVE MATERIALS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUMMARY

- A. This Section includes stock, manufactured toilet compartments.
- B. Types of toilet and shower compartments include:
 - 1. Solid plastic, homogenous color
- C. Styles of toilet compartments include:
 - Floor-anchored, overhead-braced
- D. Toilet accessories, such as toilet paper holders, and grab bars are specified in another Division 10 Section.

1.06 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
 - 1. Product data for materials, fabrication, and installation including catalog cuts of anchors, hardware, fastenings, and accessories
 - 2. Shop drawings for fabrication and erection of toilet compartment assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work
 - 3. Samples of full range of colors for each type of unit required: Submit 6-inch-square samples of each color and finish on same substrate to be used in work, for color verification after selections have been made.
 - 4. Manufacturer's Installation Instructions: Indicate special procedures; perimeter conditions requiring special attention.

1.07 QUALITY ASSURANCE

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of work. However, allow for adjustments where taking of field measurements before fabrication might delay work.
- B. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet compartments and related items. Coordinate delivery with other work to avoid delay.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
- B. Manufacturer: Subject to compliance with requirements, provide products by one of the following including, but are not limited to:
 - 1. Solid Plastic Polymer Resin:
 - a. Accurate Partitions (ASI)
 - b. AMPCO Products LLC
 - c. Crane-Sany Metal
 - d. General Partitions (Only supplies 4 samples)
 - e. Global Partitions
 - f. Legacy Polymer Products, Inc.
 - g. Metpar Corp.
 - h. Mills, Inc.
 - i. PSISC Columbia Partitions
 - j. Rockville Partitions
 - k. Scranton Products
 - 1. Trident Partition Systems
 - m. Hadrian, Inc.

2.02 SOLID PLASTIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE).
 - Color: To be selected from the full line of hammered texture or metallic finishes.
- B. Doors:
 - 1. Thickness: 1 inch
 - 2. Height: 55 inch
- C. Panels:
 - 1. Thickness: 1 inch
 - 2. Height: 55 inch
 - 3. Depth: As indicated on drawings
- D. Pilasters:
 - 1. Thickness: 1 inch
 - 2. Width: As required to fit space; minimum 3 inch
- E. Screens: Without doors; to match compartments; mounted to wall with a continuous bracket, Size: 48" H and 18" W.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish

- 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow
- C. Wall and Pilaster (or Pilaster) Brackets: Anodized aluminum
- D. Wall Brackets: Continuous type, natural anodized aluminum
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts, tamper proof
- F. Hardware: Satin stainless steel or natural anodized aluminum
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door
 - 2. Nylon bearings
 - 3. Door Latch: Slide type or Thumbturn type
 - 4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch
 - 5. Coat hook with rubber bumper; one per compartment, mounted on door
 - 6. Provide door pull for outswinging doors. Provide pulls on both faces of handicapped compartment doors.
- G. Wall Bumper: Provide two aluminum wall bumpers at handicapped toilet door and any other location where standard bumper does not adequately prevent door from striking wall or other accessories.
 Zamac is not acceptable. Locate bumpers at the top and bottom of the door to prevent the door from flexing and striking the wall or other obstruction.
- H. Heat Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.

2.04 FABRICATION

- A. General: Furnish standard doors, panels, screens, and pilasters fabricated for compartment system. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as indicated.
- B. Door Dimensions: Unless otherwise indicated, furnish 24-inch-wide in-swinging doors for ordinary toilet stalls and 32-inch-wide (clear opening) out-swinging doors for stalls equipped for use by handicapped.
- C. Overhead-Braced Compartments: Furnish galvanized steel supports and leveling bolts at pilasters as recommended by manufacturer to suit floor conditions. Make provisions for setting and securing continuous, extruded, aluminum, antigrip, overhead bracing at top of each pilaster. Provide shoe at each pilaster to conceal supports and leveling mechanism.
- D. Wall-Hung Screens: Furnish panel units in sizes indicated, of same construction and finish as partition system panels.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. General: Comply with manufacturer's recommended procedures and installation sequence. Install compartment units rigid, straight, plumb, and level. Secure panels to walls with a continuous

- aluminum wall bracket. Secure panels to pilasters with a continuous aluminum panel/pilaster bracket to align with wall bracket. Secure panels in position with manufacturer's recommended anchoring devices.
- B. Overhead-Braced Compartments: Secure pilasters to floor and level, plumb, and tighten installation with devices furnished. Secure overhead brace to each pilaster with not less than two fasteners. Hang doors and adjust so that tops of doors are parallel with overhead brace when doors are in closed position.
- C. Screens: Attach with anchoring devices as recommended by manufacturer using a continuous aluminum wall bracket. Set units to provide support and to resist lateral impact.
- D. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch
- B. Maximum Variation From Plumb: 1/8 inch

3.04 ADJUST AND CLEAN

- A. Hardware Adjustment: Adjust and lubricate hardware for proper operation. Set hinge on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinge on out-swinging doors (and entrance swing doors) to return to fully closed position.
- B. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION

SECTION 102600 - WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards. Corner guards to be installed on all gypsum board outside wall corners.

1.02 REFERENCES

- A. ANSI/ICC A117.1 American National Standard for Accessible and Usable Buildings and Facilities, International Code Council; 2003.
- B. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2007.
- C. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Materials; 2007.

1.03 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
- C. Samples: Submit two sections of wall and corner guards, 24 inch long, illustrating component design, configuration, color and finish.

1.04 PROJECT CONDITIONS

A. Coordinate the work with wall or partition sections for installation of concealed blocking or anchor devices.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wall and Corner Guards:
 - 1. Alpar Architectural Products
 - 2. Arden Architectural Specialties, Inc.: Product equivalent to IPC 160 BN
 - 3. Construction Specialties, Inc.: Product equivalent to IPC 160 BN
 - 4. C/S Group
 - 5. IPC/InPro Corporation; Product 160 BN
 - 6. Koroseal Interior Products Group
 - 7. Substitutions: See Section 016000 Product Requirements

2.02 COMPONENTS

- A. Corner Guard (CG1)- Surface Mounted: High impact vinyl with extruded aluminum full height retainer and integral impact absorbing device.
 - 1. Manufacturer: Inpro
 - 2. Product: 160BN Bullnose Surface Mounted
 - 3. Height: 8' (2.44m)
 - 4. Vinyl Cover: 080" (2mm)
 - 5. Vinyl Retainer: .070 (1.8mm)
 - 6. Color: As selected from manufacturer's standards
 - 7. Note: Cut to size in field
 - 8. Locations: Refer to the drawings
 - 9. Length: One piece
 - 10. Preformed end caps

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough-in for components are correctly sized and located.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Position corner guard 4 inches above finished floor to 48 inches high.

END OF SECTION

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following toilet accessory items:
 - 1. Grab bars (toilets and showers)
 - 2. Mop and broom holder (located at each mop sink)
 - 3. Sanitary napkin disposal unit (surface-mounted)
 - 4. Underlayatory guard
 - 5. Floor standing stainless steel waste receptacles
 - 6. Steel Framed Mirror

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product Data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.
- C. Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.

1.04 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.
- B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.
- C. ADA Compliance: Provide products which comply with applicable provisions of the Americans with Disabilities Act.

1.05 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.06 WARRANTY

A. Special Project Warranty: Provide manufacturer's written 5-year warranty against silver spoilage of mirrors, agreeing to replace any mirrors that develop visible defects within warranty period.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following including, but not limited to:
 - 1. A & J Washroom Accessories
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation
 - 5. General Accessory Manufacturing Co.

- 6. Royce Rolls Ringer Co.
- 7. Columbia Accessories
- 8. Saniflow
- 9. Gamco
- 10. Searchrome

2.02 MATERIALS, GENERAL

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gage (.034-inch) minimum thickness, unless otherwise indicated.
- B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16, Castings, ASTM B-30.
- C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 20-gage (.040-inch) minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 527, G60.
- E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.
- F. Mirror Glass: Nominal 6.0 mm (0.23 inch) thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.
- G. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- H. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.
- I. Keys: Unless otherwise indicated, provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six (6) keys to Owner's representative and obtain receipt.

2.03 GRAB BARS

- A. Stainless Steel Type: Provide grab bars with wall thickness not less than 18 gage (.050 inch) and as follows:
 - 1. Mounting: Concealed, manufacturer's standard anchorages
 - 2. Clearance: 1-1/2 inches clearance between wall surface and inside face of bar
 - 3. Gripping Surfaces: Smooth, satin finish
 - 4. Heavy-Duty Size: Outside diameter of 1-1/2 inches
 - 5. Anchorage: Grab bar and anchorages shall have capacity to withstand minimum 250 lb. pull in any direction of aluminum duration of 5 minutes.
 - 6. Product: Bobrick B-6806 or approved equivalent
 - 7. Refer to drawings for sizes and quantities.

2.04 MISCELLANEOUS ACCESSORIES

- A. Mop and Broom Holder: 18-gage (.050-inch) Type 304 stainless steel "hat" channel with spring-loaded rubber cam-type mop/broom holders that grips handles 7/8" to 1-1/4" diameter. Provide 24" long unit with 3 holders.
 - 1. Product: Bobrick B-223 or approved equivalent

2.05 SANITARY NAPKIN DISPOSAL UNIT (SURFACE-MOUNTED)

- A. Sanitary Napkin Disposal Unit: Where this designation is indicated, provide stainless steel sanitary napkin disposal unit complying with the following:
 - 1. Products: Available products include the following:
 - a. American Specialties, Inc., No. 0852 or approved equivalent.

2.06 UNDERLAVATORY GUARD

- A. Underlavatory Guard: Handicapped sink locations will receive underlavatory guard complying with the following:
 - 1. Products: Available products include the following:
 - a. Insulating Piping Coverings: White, anti-microbial, molded-vinyl covering for supply and drain piping assemblies intended to use at accessible lavatories to prevent direct contact with burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

2.07 FLOOR STANDING STAINLESS STEEL WASTE RECEPTACLES

- A. Floor Standing Waste Receptacle:
 - 1. Waste Receptacle: 22 gauge stainless steel with satin finish. Equipped with vinyl bumper strip and rubber feet.
- B. Liner: Removable liner
- C. Cover: 22 gauge stainless steel with satin finish. Two spring loaded, self-closing doors, which have an international graphic symbol to identify waste disposal, are secured with full-length, stainless steel piano-hinges.
- D. Model: Bobrick No. B-2250 or approved equivalent
- E. Quantity: Four

2.08 FABRICATION

- A. General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item by either a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
- C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.
- D. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamper proof glass installation and prevent accumulation of moisture, as follows:
 - 1. Provide galvanized steel backing sheet, not less than 22 gage (.034 inch) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- E. Mirror Unit Hangers: Provide system of mounting mirror units that will permit rigid, tamper proof, and theft-proof installation, as follows:
 - 1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove.

2.09 STEEL FRAMED MIRROR

A. In lieu of plate glass mirrors, provide stainless steel framed mirrors equal to Bobrick no B-165. The mirrors shall have type 430 stainless steel 1/2" X 1/2" X 3/8" channel with 1/4" return with bright polished finish. Mirrors shall have locking devices to secure mirrors to wall hangers. Concealed Philips-head locking screws shall securely fasten mirrors to wall hangers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install toilet accessory units in accordance with manufacturers' instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper proof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

3.02 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION

SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher brackets.

1.02 RELATED REQUIREMENTS

- A. Section 061000 Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 042000 Unit Masonry: Roughed-in wall openings.
- C. Section 092116 Gypsum Board Assemblies: Roughed-in wall openings.

1.03 REFERENCE STANDARDS

- A. International Building Code; 2015 with Kentucky Amendments; current edition.
- B. IFC International Fire Code; 2012.
- C. NFPA 10 Standard for Portable Fire Extinguishers; 2013.
- D. UL (DIR) Online Certifications Directory; current listings at database.ul.com.

1.04 PERFORMANCE REQUIREMENTS

- A. Conform to International Fire code.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.05 SUBMITTALS

- Shop Drawings: Indicate locations of individual fire extinquishers and mounting measurements for wall bracket.
- B. Product Data: Provide extinguisher operational features.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.06 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers, Cabinets, Brackets and Accessories: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1. Basis of Design: concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Bracket J. L. Industries; Bracket 10 lb; MB 846.
 - b. Bracket J. L. Industries; Bracket 15 lb; MB 810.
 - c. Fire Extinguisher J. L. Industries; Cosmic 10E (Class A, B, C).

- d. Fire Extinguisher J. L. Industries; Saturn 15 (Class K).
- e. Fire Extinguisher J. L. Industries; Sentinel 15 (Class B, C)
- 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect:
 - a. Activar Inc.; JL Industries, Inc: www.activarcpg.com/jl-industries
 - b. Larsen's Manufacturing Co: www.larsensmfg.com.
 - c. Morris Group International/Potter-Roemer: www.potterroemer.com.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Dry Chemical Type Fire Extinguishers: Heavy-duty steel tank, with pressure gage.
 - 1. Class A, B, C.Multi-purpose
 - 2. Size 10 pound.
 - 3. Tank Finish: Corrosion and impact resistant powder coat.
 - 4. Tank Color: Red.
 - 5. Location: All areas of building.
 - 6. Mounting Type: Refer to drawings for bracket mount symbol.
- C. Wet Chemical Type Fire Extinguisher: Stainless steel tank, with pressure gage.
 - 1. Class K
 - 2. Size: 15 pound
 - 3. Location(s): Install at all kitchens/concessions/food service preparation areas within 30 feet of any hood located above cooking equipment or any cooking equipment involving solid fuels, vegetable or animal oils and fats whether or not located under a hood.
 - 4. Mounting Type: Bracket
- D. Carbon Dioxide Type Fire Extinguishers: Aluminum tank, with pressure gauge.
 - 1. Class: B:C type.
 - 2. Size: 15 pound.
 - 3. Finish: Baked polyester powder coat, red color.
 - 4. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 BRACKETS AND ACCESSORIES

- A. Extinguisher Bracket: Formed steel, powder-coat paint finish.
 - 1. Color: Red

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install brackets so the top of the fire extinguisher is not more than 4 feet above the finished floor.
- C. Secure brackets rigidly in place.
- D. Place extinguishers on wall brackets.
- E. All fire extinguishers to arrive at the job site fully charged.

1. Some fire extinguisher manufacturers will not ship Class K fire extinguishers to the job site fully charged. If required, Class K fire extinguishers are to be charged at the job site by a qualified fire extinguishing professional.

3.03 SCHEDULES

- A. FE-1 Fire extinguisher and bracket.
- B. FE-2 Fire extinguisher and bracket CO2 Type.
- C. FE-3 Fire extinguisher and bracket near range hood in kitchen.

END OF SECTION 104400

SECTION 105050 - METAL LOCKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 9 Section 090050 Finish Legend

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Metal Lockers:
 - a. New Kitchen Lockers: Double Tier Lockers (ML1)
 - Double tier lockers with Owner-provided locks and sloping top, knocked-down construction and metal base. Manufacturer's standard colors.
- B. Related Sections include the following:
 - 1. Division 6 Section "Miscellaneous Carpentry" for wood furring and grounds

1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Show sloping tops, locker fillers, trim, base and accessories. Include locker-numbering sequence in student and kitchen staff lockers.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.
 - 1. Lockers
- E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 1.

1.04 OUALITY ASSURANCE

A. Source Limitations: Obtain locker units and accessories through one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.
- B. Protect lockers from damage during delivery, handling, storage, and installation.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following including, but not limited to:
 - 1. Art Metal Products
 - 2. DeBourgh
 - 3. List industries
 - 4. Lyon Metal Products, Inc.
 - 5. Penco Products, Inc.; Subsidiary of Vesper Corporation
 - 6. Republic Storage Systems Co., Inc.
 - Lockers MFG
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Metal Locker Schedule at the end of Part 3.

2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 366/A 366M, matte finish, suitable for exposed applications, and stretcher leveled or roller leveled to stretcher-leveled flatness.
- B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

2.03 WARDROBE LOCKERS-KITCHEN

- A. Body: Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; flanged for double thickness at back vertical corners. Comply with the following:
 - 1. Supply HDC Heavy-duty Corridor Lockers with 14 gauge doors, 16 gauge top, bottom and shelves and 24 gauge sides and back.
- B. Frames: Form channel frames from minimum 0.0598-inch- (1.50-mm-) thick steel sheet; lapped and welded at corners. Form continuous integral door strike on vertical frame members. Provide resilient bumpers to cushion door closing.
 - 1. Latch Hooks: Form from minimum 0.1046-inch- (2.70-mm-) thick steel; welded or riveted to door frames
 - 2. Cross Frames: Form intermediate channel cross frames between tiers from minimum 0.0598-inch- (1.50-mm-) thick steel sheet. Weld to vertical frame members.
 - 3. Frame Vents: Fabricate vertical face frames with vents.
- C. Doors: One-piece steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees. Comply with the following:
 - 1. Reinforcement: Brace or reinforce inner face of doors more than 15 inches (381 mm) wide.
 - 2. Reinforcing and Sound-Dampening Panels: Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.
 - 3. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact.
 - 4. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen door surface and reduce sound levels when door is slammed, of die-formed metal with full perimeter flange and sound-dampening material. Spot weld panel to inside of door.
 - 5. Louvered Vents: Stamped, louvered vents in door face, as follows:
- D. Continuous Hinges: Manufacturer's standard, steel continuous hinge mounted to door and frame.

- E. Recessed Handle and Latch: Manufacturer's standard housing, formed from 0.0359-inch- (0.90-mm-) thick nickel-plated steel or stainless steel, with integral door pull, recessed for latch lifter and locking devices; nonprotruding latch lifter; and automatic, prelocking, pry-resistant latch, as follows:
 - 1. Provide minimum three-point latching for each door more than 42 inches (1067 mm) high; minimum two-point latching for each door 42 inches (1067 mm) high or less.
 - 2. Provide single-point gravity or spring-actuated latch with padlock lug.

2.04 LOCKS

- A. Fabricate lockers to receive the following locking devices, installed on lockers using security-type fasteners:
 - 1. Owner Provided Combination Locks:
 - a. Bolt Operation: Manually locking dead bolt or automatically locking spring bolt, as standard with manufacturer.
 - 2. ADA compliant lockers shall receive Digilock Range Lock, Kyless Co., or approved equivalent.

2.05 LOCKER ACCESSORIES

- A. Interior Equipment: Furnish each locker with the following items, unless otherwise indicated:
 - 1. Hooks: Manufacturer's standard zinc-plated, ball-pointed steel. Provide one double-prong ceiling hook, and not fewer than two single-prong wall hooks. Attach hooks with at least two fasteners.
- B. Number Plates: Manufacturer's standard etched, embossed, or stamped, aluminum number plates with numerals at least 3/8 inch (9 mm) high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
- C. Recess Trim: Manufacturer's standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet, minimum 2-1/2-inch (64-mm) face width, and finished to match lockers. Fabricate trim in lengths as long as practicable.
- D. Filler Panels: Manufacturer's standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet in an unequal leg angle shape, and finished to match lockers. Provide slip joint filler angle formed to receive filler panel.
- E. Finished End Panels: Manufacturer's standard; fabricated from minimum 0.0239-inch- (0.60-mm-) thick steel sheet, finished to match lockers, and designed for concealing exposed ends of nonrecessed lockers.
- F. Continuously Sloping Tops: Manufacturer's standard, fabricated from minimum 0.0359 inch- (.90 mm) thick steel sheet, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practicable, without visible fasteners at splice locations, finished to match lockers. Provide fasteners, filler plates, supports, and closures, as follows:
 - 1. Closures: Vertical-end type
 - 2. Sloped top corner fillers, mitered

2.06 FABRICATION

- A. Unit Principle: Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.
- B. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
- Form locker-body panels, doors, shelves and accessories from one-piece steel sheet, unless otherwise indicated.

2.07 FINISHES, GENERAL

- A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.08 STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.4 mils (0.036 mm) on doors, frames, and legs, and 1.1 mils (0.028 mm) elsewhere.
- C. Powder-Coated Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer finish consisting of a thermosetting powder topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1 mil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer's written instructions.
- B. Assemble knocked-down lockers with standard fasteners, with no exposed fasteners on door faces and face frames.
- C. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.
- D. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
- E. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed lockers.
- F. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed lockers.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

- B. Clean interior and exposed exterior surfaces and polish stainless-steel and nonferrous-metal surfaces.
- C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.
- D. Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

3.04 METAL LOCKER SCHEDULE

- A. Metal Wardrobe Locker (ML1): Where metal lockers of this designation are indicated, provide products complying with the following:
 - 1. Style: Double Tier
 - 2. Material: Cold-rolled steel sheet
 - 3. Back Material Thickness: 24 gauge
 - 4. Side Material Thickness: 24 gauge
 - 5. Door Material Thickness: 14 gauge
 - 6. Locker Arrangement: Double tier, refer to plans for locations and quantities.
 - 7. Backs: Solid
 - 8. Sides: Solid
 - 9. Door Style: Louvered vents
 - 10. Shelves: Solid
 - 11. Hinges: Side mounted continuous
 - 12. Handles/Latches: Recessed
 - 13. Locks: Built-in combination lock or Owner-provided padlock
 - 14. Color: Selected from manufacturer's standards
 - 15. Size: 12" x 12" x 72" H
 - 16. Base: Metal legs
 - 17. Provide ADA compliant lockers at all (#?) designations.

END OF SECTION

SECTION 107300 - ALUMINUM CANOPY

PART 1-GENERAL

1.01 SECTION INCLUDES

- A. Wall supported manufactured aluminum canopy.
 - 1. Downspouts will be connected to the storm drainage system.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-In-Place Concrete
- B. Section 042000 Unit Masonry
- C. Section 079000 Joint Sealants

1.03 REFERENCE STANDARDS

- A. AAMA 611 Specification for Anodized Architectural Aluminum.
- B. AAMA 2604 Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- C. AAMA 2605 Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- D. ASTM B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. ASTM B 221 Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles and Tubes.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Wall supported canopy, canopy attachment to wall, metal deck, beams, and fascia.
 - 2. Column supported canopy, columns, column embedment, metal deck, beams and fascia.
- B. Shop Drawings: Detail fabrication and installation of all formed metal fabrications. Include dimensioned plans, elevations, sections, and details of components and their connections. Show anchorage and accessory items.
 - 1. Show downspout attachment to storm drainage system.
 - 2. Show column/downspout foundation attachment.
 - 3. Manufacturer to field verify project conditions for wall bracket attachments to ensure proper attachment is indicated in the shop drawings.
- C. Field Measurements: Where formed metal canopies are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Design Data: Submit design calculations bearing the seal of a Registered Professional Engineer, licensed in Kentucky. Design calculations shall state that the canopy system design complies with the wind uplift requirements of ASCE 7, the stability criteria of the 2015 IBC with Kentucky Amendments, and all other governing criteria.
- E. Selection Samples: Submit color chips representing manufacturer's full range of available colors and patterns. Submit actual samples not photo reproductions.

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1.05 KENTUCKY DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION (HBC) SUBMITTALS

- A. In addition to the shop drawings submitted to the Architect for review the pre-engineered metal canopy manufacturer shall also submit shop drawings to the pre-engineered canopy installer for shop drawings submittal to HBC for approval as a requirement of the building permit.
- B. Shop Drawings: Each sheet shall be identified with the project name and bear the seal and signature of a Kentucky licensed design professional. Section 107.1 2015 IBC with KY Amendments, current edition.

1.06 OUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of canopy system, as specified, with minimum ten years of documented experience.
- B. Installer Qualifications: Canopies to be installed by the manufacturer. Third party installation is not acceptable, unless installer is certified through the manufacturer, or installs manufacturers canopies exclusively.
- C. Source Limitations: Obtain canopies through one source from a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver formed metal canopies wrapped in protective coverings and strapped together in suitable packs or in heavy duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
- B. Store products on elevated platforms in a dry location.

1.08 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, gloss reduction, chalking, or flaking.
 - 1. Provide if manufacturers standard finish is anodized or powder-coated.
- C. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
 - 1. Provide if manufacturers standard finish is painted.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- B. Basis of Design: design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1. Superior Mason Products, LLC.
- C. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - 1. Architectural Fabrication, Inc.: www.arch-fab.com
 - 2. Childers Carports and Structures: www.childersonline.com
 - 3. Mapes Industries:www.mapes.com
 - 4. MASA Corporation: www.architecturalcanopies.com
 - 5. Mitchell Metals, LLC: www.mitchellmetals.net

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- 6. Peachtree Protective Covers: www.peachtreecovers.com
- 7. Superior Mason Products, LLC: www.superiormetalproducts.com
- 8. Tennessee Valley Metals: www.tvmetals.com
- 9. Rusco Custom Canopies: www.ruscocanopies.com

2.02 MATERIALS

- A. General: Provide materials without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Aluminum Members: Extruded aluminum, ASTM B 221, 6063 alloy, T6 temper.
- C. Deck Panels: Extruded .062 inch aluminum flush deck
 - 1. Panel Profile: Flat
 - a. Deck must be continuously flat across the entire canopy. Deck profile or deck attachment to not create any open spaces to allow bird nesting/roosting.
- D. Intermediate Gutters/Drain Beam: Extruded .125 inch aluminum with one end closed at the factory and be provided with top cap that is removable for cleaning.
 - 1. Intermediate Gutter Size: Manufacturers standard size or nominal, 0.188 inch thick, 3 inch wide x 6 inch deep.
- E. Fascia/Gutter: Full perimeter extruded .094 inch aluminum fascia/gutter.
 - 1. Fascia Size: Manufacturers standard size or nominal, 0.070 inch thick, 3 inch wide x 7 inch deep to interlock with decking and gutters.
- F. Downspouts that are not a supporting column: Fully welded, extruded aluminum tubing, minimum wall thickness of 0.125 inch. Minimum size 3 inch by 3 inch or size as indicated on the drawings.
- G. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 - 1. Provide concealed fasteners for interconnecting formed metal fabrications and for attaching them to other work, unless otherwise indicated.
 - 2. Fasteners to be provided in same finish and color as canopy components.
- H. Structural Anchors and Rods: All ferrous fasteners and hanging accessories shall be heavily galvanized or cadmium plated and finished in same finish and color as other canopy components.
- I. Flashing: Flashing shall be made of aluminum sheet in same finish and color as the other canopy components. Minimum flashing thickness to be 0.040 inch thick. Coordinate installation of flashing with masonry and/or roofing subcontractor to integrate flashing into throughwall flashing and reglets.
- J. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.03 ACCESSORIES

A. Wire Ball Downspout Strainer: Install wire ball downspout strainer at each downspout location.

2.04 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble formed metal canopies in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Coordinate dimensions and attachment methods of formed metal canopies with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.
- C. Welding: In accordance with ANSI/AWS D1.2.

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- D. Bent Construction: Factory weld beams to columns with neatly mitered corners to form one piece rigid bents. Make welds smooth and uniform using an inert gas shielded arc. perform suitable edge preparation to assure 100% penetration. Grind welds only where interfering with adjacent structure to allow for flush connection. Field welding is not permitted.
- E. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. fasten interlocking joints at on center spacing creating a monolithic structural unit capable of developing the full strength of the sections. Fastening to have minimum shear strength of 350 pounds each. Assemble deck with sufficient camber to offset dead load deflection.
- F. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2 inch (12 mm) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.
- G. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed metal units as needed to attach and support other construction.
- H. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install formed metal fabrications.

2.05 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication, unless otherwise indicated.

2.06 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.
- C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- D. Canopy finishes: Due to differences in canopy manufacturer finishing standards provisions for clear and/or color anodized, painted and powder coated material is included. All finishes are acceptable and manufacturers are to provide their standard of ONE listed below.
 - Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating or AAMA 612 clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils thick.
 - a. Color to be clear anodized.
 - All canopy components to be clear anodized; fascia, deck, wall hangers, and drain beam.
 - 2. High-Performance Organic Finish (2-coat Fluoropolymer): AA-C12C40R1X (Chemical Finish): cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to

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exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

- a. Finish to be Pearledize/Mica, consisting of 0.2 mil primer with 0.8 mil color coat containing mica pearlescent flakes to simulate the appearance of an anodized/metallic finish.
- b. Color to be selected from manufacturers standard color chart. Minimum twenty colors.
 - 1) Color simulating clear anodized aluminum to be available in color choices.
- All canopy components to be painted; fascia, deck, wall hangers, accessories, and drain beam.
- d. Extruded deck to be painted the same color on the topside and underside.
- 3. Powder Coated Finish: AAMA 2604 thermosetting resin of, 1.20 mils minimum, modified polyesters electrostatically applied to the aluminum profile. Profile to be baked in an oven where the powder particles are melted to a liquid state, fusing together to form a homogenous film.
 - a. Color to be selected from manufacturers standard color chart. Minimum sixteen colors.
 - 1) Color simulating clear anodized aluminum to be available in color choices.
 - b. All canopy components to be painted; fascia, deck, wall hangers, accessories, and drain beam.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Locate and place formed metal fabrications level, plumb, and in alignment with adjacent construction.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Corrosion Protection: Coat concealed surfaces of aluminum, zinc coated, and nonferrous metals that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- E. Entire unit shall be erected straight and true.
- F. Hanger rods shall be anchored using through bolt type anchors to support dead and live loads, as recommended by the manufacturer.

3.02 ADJUSTING

A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.03 PROTECTION

A. Protect finishes of formed metal canopies from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 107300

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SECTION 122413 - MANUALLY OPERATED WINDOW SHADES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes: Manually operated, roll-up fabric window shades (RWS1) including mounting and operating hardware. Shades shall occur on the exterior windows in student lounge 204 on the plan south wall at TWS1 designations..

1.02 RELATED REQUIREMENTS

- A. Division 1 Specifications Sections for Submittal Procedures.
- B. Section 012300 Alternates: Refer to Section for additional information.
- C. Section 079005 Joint Sealers: Acoustic sealant/sound caulk.
- D. Section 090050 Finish Legend.
- E. Section 092116 Gypsum Board Assemblies: Suspended gypsum board ceiling recessed window shade pockets.
- F. Section 095113 Acoustical Panel Ceilings: Suspended acoustical panel ceilings to contain recessed window shade pockets.

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. Submit in accordance with Division 1 Specifications Sections for Submittal Procedures:
 - 1. List of proposed products and product data
 - 2. Shop drawings showing window openings, dimensions, and attachment method
 - 3. Samples for selection by Interior Designer:
 - a. Fabrics Phifer Sheerweave Infinity
 - 4. Window Shade Schedule listing rooms, field verified window dimensions, quantities, type of shade, fabric, and color
 - 5. Manufacturer's installation and maintenance instructions

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.
- B. NFPA Flame-Test: Passed NFPA 701. Materials tested shall be identical to products proposed for use.
- C. Store products in manufacturer's unopened packaging until ready for installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.

1.07 PROJECT CONDITIONS

- A. Install roller shades after finish work and ambient temperature, humidity, and ventilation conditions are maintained at levels recommended for project upon completion.
- B. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruptions of constuction progress.
- C. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

A. Provide under provisions of Division 1 Specifications Sections for Contract Closeout: 5 years warranty against defects in materials and workmanship for clutch operating mechanism.

PARTS 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Draper, Inc., 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999
- B. Springs Window Fashions Division, Inc.
- C. Hunter Douglas Window Fashions
- D. Lutron
- E. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 Product Substitution Procedures.

2.02 MANUALLY OPERATED WINDOW SHADES

- A. Type: Manually operated, vertical roll-up, fabric window shade with bead chain and clutch operating mechanism, mounting brackets, fasteners, and other components necessary for complete installation; Equal to FlexShade as manufactured by Draper, Inc.
- B. Method of installation: Mounted inside of window opening and extending from head to sill and jamb to jamb.

- C. Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide preset limit stops to prevent shade from being raised or lowered too far.
 - 1. Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon
 - 2. Control loop: Stainless steel bead chain hanging at side of window
 - 3. Chain location: Right hand side when facing window from interior

2.03 HARDWARE

- A. Mounting Brackets: 1018 plated steel stamping. Sizes 1 5/8" and 2 1/4". Mount to face, ceiling or jamb. Brackets do not require additional adapters.
- B. Fascia: L-shaped cover of extruded aluminum, .060 wall. Snap-lock assembly to end caps without exposed fasteners. Anodized Aluminum (standard) finish or black, white, ivory or bronze powder coat finish.

2.04 FABRIC

A. Material: Manufacturer's standard 3% open light filtering fabric equal to SheerWeave 2400.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Field verify window dimensions prior to fabrication.
- B. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.

3.02 INSTALLATION

- A. Install window shades at locations indicated on drawings and approved Window Shade Schedule.
- B. Comply with shade manufacturer's written instructions and approved shop drawings.
- Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
- D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
 - 1. Fascias
 - 2. Closure panels
 - 3. Endcaps
- E. Position shades level, plumb, and at proper height relative to adjacent construction. Secure with fasteners recommended by manufacturer.

3.03 ADJUSTING AND CLEANING

- A. Operate shade through complete cycle of lowering, stopping, and raising to ensure proper operation. Adjust as required for smooth operation.
- B. Clean shade assemblies and protect from damage from construction operations. If damage occurs, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 123550 - INSTITUTIONAL CASEWORK

PART 1-GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - Plastic laminate faced wood cabinets of stock design
- B. In some instances specific manufacturer's model numbers have been used to more clearly define the casework design and are not provided to preclude other acceptable manufacturer's from supplying equal products.
- C. Related Sections include the following: List below only products and construction that the reader might expect to find in this Section but are specified elsewhere.
 - Division 6 Section "Miscellaneous Carpentry" for wood blocking for anchoring institutional casework
 - 2. Division 6 Section "Interior Architectural Woodwork" (Custom Millwork)
 - 3. Division 9 Section "Gypsum Drywall" for reinforcements in gypsum board partitions for anchoring institutional casework
 - 4. Division 9 Section "Resilient Wall Base and Accessories" for resilient base applied to institutional casework

1.02 RELATED REQUIREMENTS

- A. Section 013000 Administrative Requirements Submittal procedures
- B. Section 090050 Finish Legend

1.03 DEFINITIONS

- A. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets. The bottom of wall cabinets are considered exposed and will receive plastic laminate.
- B. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.04 REFERENCE STANDARDS

- A. AISI SG02-1 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Shop Drawings: Show fabrication and installation details for institutional casework. Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated
- D. Samples for Verification: 6-inch- (150-mm-) square Samples for each type of finish, including top material and the following:
 - 1. Section of countertop showing top, front edge, and backsplash construction

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of institutional casework manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain institutional casework through one source from a single manufacturer.
- C. Quality Standard: Build and install to AWI quality standards.
- D. Product Designations: Drawings indicate sizes, configurations, and finish material of institutional casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Division 1 Section "Product Requirements."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver institutional casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install institutional casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify all dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
 - Established Dimensions: Where field measurements cannot be made without delaying the
 Work, establish dimensions and proceed with fabricating institutional casework without field
 measurements. Coordinate construction to ensure that actual dimensions correspond to
 established dimensions.

1.09 COORDINATION

A. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of institutional casework.

1.10 SEQUENCING AND SCHEDULING

A. Coordinate the work with all sections referencing this section.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of institutional casework that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Delamination of components or other failures of glue bond
 - 2. Warping of components
 - 3. Failure of operating hardware
 - 4. Deterioration of finishes
 - 5. Warranty Period: Five years from date of substantial completion

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: The design for institutional casework is based on TMI Systems Design Corp. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
- C. Plastic Laminate Faced Institutional Casework:
 - 1. Action Outfitters
 - 2. Advanced Cabinet Systems
 - 3. Advantage Millwork
 - 4. America's Finest Woodworking Team
 - 5. Architectural Cabinet Systems; Division of Windham Millwork, Inc.
 - 6. Case Systems, Inc.
 - 7. Caseworks of Kentucky
 - 8. Creative Cabinets
 - 9. Cumberland Manufacturing
 - 10. Custom Casework
 - 11. Custom Creations
 - 12. Diversified Woodworking
 - 13. Euronique, Inc.
 - 14. Fisher Hamilton Inc.
 - 15. Hamilton Sorter
 - 16. Hausmann Industries, Inc.
 - 17. Interior Wood Specialties, Inc.
 - 18. Kentucky Mill & Casework
 - 19. Leininger Cabinets
 - 20. Louisville Lumber
 - 21. LSI Corporation of America, Inc.
 - 22. Morgan Smith Industries
 - 23. Norlab, Inc.
 - 24. Polyvision Corporation
 - 25. Procase Countertops
 - 26. Riverside Mill
 - 27. Smith's Laminating
 - 28. Southern Cabinetry, Inc.
 - 29. Stevens Industries, Inc.
 - 30. Tate Ornamental
 - 31. Techline
 - 32. Terrill Manufacturing Company
 - 33. TMI Systems Design Corp.
 - 34. Top Service

- 35. U.S. Millwork
- 36. Wenger Co.
- 37. Westmark Commercial Casework
- D. Plastic Laminate Material:
 - 1. Arborite
 - 2. Formica Corporation
 - 3. Nevamar
 - 4. Wilsonart International; Div. of Premark International, Inc.
- E. Rigid PVC Extrusions (3mm & 1mm):
 - Wood Tape

2.02 MATERIALS

- A. General:
 - Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood
 - 2. Hardwood Plywood: HPVA HP-1, either veneer core or particle core, unless otherwise indicated
 - 3. Softwood Plywood: DOC PS 1
 - 4. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue
 - 5. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue
 - 6. Hardboard: AHA A135.4, Class 1 Tempered
 - 7. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3
 - 8. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere
- B. Exposed Cabinet Materials:
 - 1. Plastic Laminate: Type VGS.
 - a. Unless otherwise indicated, provide plastic laminate for exposed surfaces.
 - b. Provide plastic laminate for doors and drawer fronts and where indicated.
- C. Semiexposed Cabinet Materials:
 - 1. Plastic Laminate: Type CLS
 - a. Provide plastic laminate for interior faces of doors and drawer fronts [only/and] where indicated.
 - 2. Melamine-Faced Particleboard: Particleboard with decorative surface of thermally fused, melamine-impregnated web and complying with LMA SAT-1
 - a. Provide melamine-faced particleboard for semiexposed surfaces, unless otherwise indicated.
 - 3. Cabinets with glass doors: provide plastic laminate to match the exterior of the cabinet unless shown otherwise on the drawings.
- D. Concealed Cabinet Materials:
 - 1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility
 - 2. Plywood: Hardwood plywood. Concealed backs of plywood with exposed or semiexposed faces shall be same species as faces.
 - 3. Plastic Laminate: Type BKL

2.03 DESIGN, COLOR, AND FINISH

- A. Design: Provide institutional casework of the following design:
 - 1. Flush overlay with wire pulls
- B. Melamine-Faced Particleboard Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range.

- C. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from plastic-laminate manufacturer's full range.
- D. Rigid PVC Extrusions (3mm & 1mm). As selected by Architect/Designer from PVC edging manufacture selections provide a minimum of 65 color/pattern selection(s).

2.04 CABINET FABRICATION

- A. Plastic-Laminate-Faced Cabinet Construction:
 - 1. Bottoms and Ends of Cabinets, Shelves, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semiexposed surfaces. The bottom of wall cabinets is considered exposed and will receive plastic laminate. The front exposed edges of the cabinet shall receive plastic laminate.
 - 2. Backs of Cabinets: 1/2-inch (12.7-mm) particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semiexposed surfaces.
 - 3. Drawer Fronts: 3/4-inch (19-mm) particleboard, plastic-laminate faced on both sides.
 - 4. Drawer Sides and Backs: 1/2-inch (12.7-mm) solid wood or plywood or particle board, with glued dovetail or multiple-dowel joints.
 - 5. Drawer Bottoms: 1/4-inch (6.4-mm) plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (12.7-mm) material for drawers more than 24 inches (600 mm) wide.
 - 6. Doors: 3/4-inch (19-mm) particleboard or medium-density fiberboard, plastic-laminate faced on both sides.
- B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.
- C. All wall and base cabinets over 3'-0" in width shall receive a vertical to prevent deflection.

2.05 CASEWORK HARDWARE

- A. Hardware, General: Provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware complying with requirements indicated.
 - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. 5-Knuckle Hinges: Chrome-plated or Powder-coated, semi-concealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches (1220 mm) high and 3 hinges for doors more than 48 inches (1220 mm) high.
- C. Pulls: Pulls as standard shall be surface mounted solid aluminum. Provide 2 pulls for drawers more than 24 inches (600 mm) wide. Wire pulls shall be 4" wide.
- D. Door Catches: Powder-coated, nylon-roller spring catch. Provide 2 catches on doors more than 48 inches (1220 mm) high.
- E. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings. Type B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf (440 N)
- F. Drawer and Cupboard Locks: Cylindrical (cam) type, 5-pin tumbler, brass with chrome-plated finish, complying with BHMA A156.11, Grade 1.
 - 1. Provide a minimum of two keys per lock and six master keys.
 - 2. Provide locks where indicated.

2.06 COUNTERTOPS

A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch (25 mm) over base cabinets.

Note: Countertops for 3 mm edge banding & radius corners.

- B. Plastic-Laminate Tops: Plastic-laminate sheet, shop bonded with waterproof glue to both sides of 1" to 1-1/4" (29-mm) plywood or particleboard. Sand surfaces to which plastic laminate is to be bonded. Plastic laminate below is standard general-purpose grade.
 - 1. Plastic-Laminate Type for Flat Tops: HGS
 - 2. Plastic-Laminate Type for Backing: BKL
 - 3. Provide PVC edgings on front edge of top, and on ends of tops.
 - 4. Use exterior plywood or phenolic-resin-bonded particleboard for countertops containing sinks.
- C. Provide grommets at all KS locations per owner's direction.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of institutional casework.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CASEWORK INSTALLATION

- A. Install plumb, level, and true; shim as required, using concealed shims. Where institutional casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).
 - 1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches (600 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).
 - 1. Fasten through back, near top and bottom, at ends, and not more than 16 inches (400 mm) o.c.
- D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises, unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.03 INSTALLATION OF TOPS

- A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

- B. Secure tops to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each front, end, and back.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and walls with adhesive.
- E. Seal junctures of top, splash, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.04 INSTALLATION OF SHELVING

- A. Securely fasten adjustable shelving supports to partition framing, wood blocking, or reinforcements in partitions.
- B. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.05 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 142010 - PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Complete commercial, standard pre-engineered hydraulic passenger elevator systems.
- B. Above ground jack, holeless.
- C. Elevator maintenance.

1.02 WORK NOT INCLUDED

- A. This specification does not include the following work, and is conditioned on the proper performance of such work by the General Contractor or other Subcontractors.
 - 1. A legal hoistway, properly framed and enclosed, and including a pit of proper depth provided with a ladder, sump pump, lights, access doors, and waterproofing, as required. Legal machine room, adequate for the elevator equipment, including floors, access doors, gratings, foundations, lighting, ventilation and heat to maintain the room at an ambient temperature of 50 degrees F. minimum to 100 degrees F maximum.
 - 2. Adequate supports and foundations to carry the loads of all equipment, including supports for guide rail brackets.
 - 3. Cutting of walls, floors, etc., and removal of such obstruction as may be necessary for proper installation of the elevator. Setting of anchors and sleeves. Pockets or blockouts or signal fixtures.
 - 4. The grouting of door sills. Finish walls after hoistway frames are installed.
 - 5. Provide and maintain temporary enclosures or other protection from open hoistways during the time the elevator is being installed.
 - 6. Proper trenching and backfilling of any underground piping or conduit.
 - Guide rail bracket inserts provided by Elevator Contractor and installed by Masonry Contractor.
 - 8. Guide rail bracket inserts provided by Elevator Contractor and installed by Steel Erector.
 - 9. A means to automatically disconnect the main line power supply to the elevator prior to the application of water in the elevator machine room will be furnished by the electrical contractor. This means shall not be self resetting.
 - 10. Removal of all dirt and debris accumulated during excavation of the jack hole to be done by the General Contractor.
 - 11. Suitable connections from the power mains to each controller or motor generator set starter, signal equipment feeders as required, including necessary circuit breakers and fused mainline disconnect switches. Auxiliary contact set for use in conjunction with emergency battery lowering is to be included.
 - 12. Wiring to controller for car lighting and ventilation. Electric power without charge, for construction, testing and adjusting, of the same characteristics as the permanent supply.
 - 13. Wiring and conduit from life safety panel or any other monitor station to elevator machine room.
 - 14. Telephone connection to elevator controller.
 - 15. Any governmentally required safety provisions not directly involved in the elevator installation.
 - 16. All painting, except as otherwise specified.
 - 17. Temporary elevator service prior to completion and acceptance of complete installation.
 - 18. Furnishing, installing and maintaining the required fire rating of elevator hoistway walls, including the penetration of fire wall by elevator fixture boxes, is not the responsibility of the elevator contractor.
 - 19. Heat and smoke sensing devices at elevator lobbies on each floor, in the machine room, and at the top and bottom of the hoistway with electrical conductors terminating at a properly marked panel in the elevator machine room.

1.03 RELATED REQUIREMENTS

- A. Section 013000 Administrative Requirements Submittal procedures.
- B. Section 015000 Temporary Facilities and Controls: Temporary power supply.
- C. Section 033000 Cast-in-Place Concrete: Includes elevator machine foundation.
- D. Section 042000 UNIT MASONRY: Masonry hoistway enclosure; building-in and grouting hoistway door frames.
- E. Section 051200 Structural Steel Framing: Includes hoistway framing.
- F. Section 055000 Metal Fabrications: Includes pit ladder, sill supports, divider beams, overhead hoist beams, and sump pit cover.
- G. Section 071400-Fluid-Applied Waterproofing: Waterproofing of elevator pit walls and floor.
- H. Section 092116 Gypsum Board Assemblies: Gypsum shaft walls.
- I. Section 096510 Resilient Flooring: Floor finish in cab.
- J. Section 223000 Plumbing Equipment: Pit drain.
- K. Section 260533.13 Conduit for Electrical Systems:
- L. Section 260583 Wiring Connections:
 - 1. Electrical characteristics and wiring connections.
 - 2. Electrical service to main disconnect in elevator machine room.
 - 3. Emergency power transfer cabinet.
 - 4. Electrical power for elevator installation and testing.
 - 5. Electrical disconnecting device to elevator equipment prior to activation of sprinkler system.
 - 6. Electrical service for machine room.
 - 7. Lighting in elevator pit.
 - 8. Empty conduit for telephone service.

1.04 REFERENCE STANDARDS

- A. ASME A17.1 Safety Code for Elevators and Escalators; 2013.
- B. ASME A17.2 Guide for Inspection of Elevators, Escalators, and Moving Walks; 2014.
- C. ASME A17.4 Guide for Emergency Personnel; The American Society of Mechanical Engineers; 1999.
- D. ASME A17.5 Elevator and Escalator Electrical Equipment; The American Society of Mechanical Engineers; 2004.
- E. ASME A17.6 Standard for Elevator Suspension, Compensations and Governor Systems; The American Society of Mechanical Engineers; 2010.
- F. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate the following information:
 - Locations of Machine Room Equipment: Driving machines, controllers, governors and other components.
 - 2. Hoistway Components: Car, counterweight, sheaves, machine and sheave beams, guide rails, buffers, ropes, and other components.

- 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
- 4. Individual weight of principal components; load reaction at points of support.
- 5. Loads on hoisting beams.
- 6. Clearances and over-travel of car and counterweight.
- 7. Locations in hoistway and machine room of traveling cables and connections for car light and telephone.
- 8. Location and sizes of access doors, doors, and frames.
- 9. Standard color charts of exposed materials for color selection by the Architect.
- 10. Expected heat dissipation of elevator equipment in machine room.
- 11. Interface with building security system.
- 12. Electrical characteristics and connection requirements.
- B. Product Data: Provide data on the following items:
 - 1. Signal and operating fixtures, operating panels, indicators.
 - 2. Cab design, dimensions, layout, and components.
 - 3. Cab and hoistway door and frame details.
 - 4. Electrical characteristics and connection requirements.
- C. Operation and Maintenance Data: Include:
- D. Certificates: Inspection and acceptance certificates of elevator system installation. Provide certificates signed by the elevator manufacturer certifying that the hoistway, pit and machine room layout and dimensions and electrical service as shown and specified are adequate for the elevator system being provided.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.
- B. Perform structural steel design, fabrication, and installation in accordance with AISC 360, Specification for Structural Steel Buildings. Perform seismic design in accordance with applicable code.
- C. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- D. Fabricate and install door and frame assemblies in accordance with NFPA 80.
- E. Perform electrical work in accordance with NFPA 70.
- F. Maintain one copy of each quality standard document on site.
- G. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- H. Installer Qualifications: Company specializing in performing the work of this section and approved by elevator equipment manufacturer.
- I. Products Requiring Fire Resistance Rating: Listed and classified by UL.
- J. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver elevator materials, components and equipment in manufacturer's protective packaging.

- B. Store materials in a dry protected area provided by others. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage, soiling, or deterioration.
- C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits, entrance subsills and electrical service, electrical outlets, lights and switches in pits and machine rooms.
- D. Use of the Elevator: Elevator shall not be used for any purpose during the construction period before Substantial Completion.

1.08 WARRANTY

A. Provide one year manufacturer warranty for elevator operating equipment, devices and to repair, restore, or replace defects in elevator work, materials, and workmanship not due to ordinary wear and tear or improper use or care for 12 months from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering the following hydraulic elevator products that may be incorporated into the work include, but are not limited to the following:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. ThyssenKrupp Elevator Endura 2500: www.thyssenkruppelevator.com.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - a. Otis Elevator Co: www.otis.com.
 - b. Schindler Elevator Corp: www.schindler.com.
 - c. Canton Elevators: www.cantonelevator.com
 - d. Global-Tardiff Elevator Manufacturing Group, Inc.: www.globaltardiff.com
 - e. ThyssenKrupp Elevators: www.thyssenkruppelevator.com
 - 3. The following Elevator Companies may supply and install elevator equipment purchased from third party manufacturers but must meet the requirements of this specification. Include, but are not limited to the following:
 - a. DC Elevator
 - 1) 709 Miles Point Way, Lexington, KY 40510
 - 2) PH. (859) 254-8224
 - 3) www.dcelevatorco.com

2.02 ELEVATORS

- A. Elevator No.1: Passenger, holeless hydraulic type with cylinder in hoistway.
 - 1. Operation and Controls: Two-stop automatic.
 - 2. Hoistway Doors and Frames: Stainless steel.
 - 3. Cab Height: 8' foot nominal.
 - 4. Cab Enclosure:
 - a. Walls: Cab type DLP, wood core panels finished on both sides with high pressure plastic laminate.
 - 1) Provide moving pad buttons.
 - b. Canopy: Reinforced 14 gauge cold rolled steel with hinged exit. Finished with two coats factory applied reflective baked enamel.
 - c. Ceiling: Downlight type metal pans with suspended LED downlights at 7'-4".
 - d. Cab Columns, Front and Transom: Stainless s steel ASTM A 167, Type 304 stainless steel panel, No. 4 satin finish.

- e. Handrail: Cylindrical, 1.5" dia. stainless steel No. 4. Provide at rear and side walls.
- f. Car Top Inspection: Provide a car top inspection station with an "emergency stop" switch and constant pressure "up-down" direction buttons to make normal operating devices inoperative and give the inspector complete control of the elevator. Mount the car top inspection station into the door operator assembly.
- 5. Hoistway and Cab Entrance Frame Opening Size: 7'-0" high x 3'-0" wide.
 - a. Formed construction of stainless steel ASTM A 167, type 304 formed stainless steel sheet, No. 4 satin finish.
- 6. Interlocks: Equip each hoistway entrance with an Underwriter's "B" label; approved type interlock tested as required by code. Interlock shall be designed to prevent operation of the car away from the landing until the doors are locked in the closed position as defined by code and shall prevent opening the doors at any landing from the corridor side unless the car is at rest at that landing or is in the leveling zone and stopping at that landing.
- 7. Door Type: Horizontal Single slide, one speed. Doors reinforced with steel for rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non- metallic shoes sliding in a smooth threshold groove.
 - a. Door Finish: Stainless steel, ASTM A 167, Type 304 stainless steel panels, No. 4 satin finish, flush construction.
 - b. Manufacturers standard entrance design, bearing Underwriter's Laboratories "B" labels, and consisting of 14 gauge frames with 2 inch profile, 16 gauge door hangers, hanger supports, hanger covers, fascia plates, sight guards and neccessary hardware.
 - c. Elevator wall interface with hoistway entrance assembly shall comply with elevator manufacturers requirements.

B. Elevator Requirements

- 1. Cab Sills: Extended, with grooved surface, 1/4" thick. Aluminum ASTM B 221 mill finish.
- 2. Door Operation: Side opening, automatic, direct current powered.
- 3. Rated Net Capacity: 2500 pounds.
- 4. Rated Speed: 100 ft./min..
- 5. Clear Net Platform Size: 5'-8" wide x 4'-3 1/2" deep.
- 6. Travel Distance: As indicated on drawings.
- 7. Number of Openings: 2 Front; 0 Rear.
- 8. Power Characteristics: 208 volts, 3 Phase, 60 Hz.
- 9. Ventilation: Two speed exhaust fan mounted on the car top.
- 10. Special Features:
 - a. Hall signal fixtures to be vandal resistant.
 - b. Car signal fixtures to be vandal resistant.
- 11. Elevator Motor: 20 HP.
- 12. Pads: Provide pad buttons on cab front and walls.

2.03 MOVING PADS

A. Moving Pads: Provide padded, quilted, fire-retardant canvas moving pads to cover all sides. Provide bound edge cutouts for control panels. Provide pads with metal grommets sized to fit pad buttons. Architect to select from manufacturers standard canvas color choices.

2.04 HOISTWAY EQUIPMENT

- A. Platform: Fabricate frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed.
- B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building with steel brackets.

- D. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.
- E. Guide Rail Lubricators: Provide a leakproof reservoir on top of upper guide shoes. Wool felt wiper shall apply an even, uniform flow of lubricant which shall thoroughly cover face of guide rail.
- F. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- G. Jack: Jack unit shall be of sufficient size to lift the gross load to the height specified. Factory test jack to insure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Jack unit shall consist of the following components:
 - 1. Heavy seamless steel tubing plunger accurately turned and polished.
 - 2. Stop ring shall be electrically welded to the plunger to prevent plunger leaving the cylinder.
 - 3. Internal guide bearing.
 - 4. Packing or seal of suitable design and quality.
 - 5. Drip ring around cylinder top.
 - 6. Cylinder made of steel pipe and provided with a pipe connection and air bleeder.
 - 7. Weld brackets to the jack cylinder for supporting the elevator on pit channels. An auxiliary safety bulkhead shall be provided in the lower end of the cylinder.
- H. Automatic Terminal Limits: Place electric limit switches in the hoistway near the terminal landings.
 Limit switches shall be designed to cutoff the electric current and stop the car if it runs beyond either terminal landing.
- I. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- J. Failure Protection: Design electrical control circuit so if a malfunction occurs, due to motor starter failure, oil becoming low in the system, or the car failing to reach a landing in the up or down direction within a predetermined time, the elevator car will automatically descend to the lowest terminal landing. If power operated doors are used, the doors will automatically open when the car reaches that landing to allow passengers to depart. The doors will then automatically close and all control buttons, except the "door open" button in the car station, shall be made inoperative.
- K. Wiring and Piping: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary pipe and fittings shall connect the power unit to the jack unit.
- L. Hydraulic Fluid/Oil: Provide necessary hydraulic fluid to power elevator as recommended and approved by the manufacturer.
 - Provide biodegradable synthetic oil as recommended and approved by the elevator manufacturer.
- M. Emergency Terminal Stopping Device: Provide emergency terminal stopping devices for speeds over 100FPM. The emergency terminal stopping device shall operate independently of the normal terminal stopping device if it fails to slow down the car at the terminal as intended. Stopping devices shall not be prevented from functioning by a single short circuit caused by a combination of grounds or by other conditions.
 - Normal and emergency terminal stopping devices shall not control the same controller switches unless two or more separate and independent switches are furnished, two of which shall be closed in either direction of travel to complete the circuit to the control valve solenoids in the down direction and to complete the circuit to the pump motor for the up direction of travel.

2.05 POWER UNIT

- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following:
 - 1. Oil reservoir with tank cover and controller compartment with cover.
 - 2. Oil hydraulic pump.
 - 3. Electric motor.
 - 4. Oil control unit with the following components built into a single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and magnetic controller.
- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Drive: Drive shall e by direct coupling with the pump and motor submerged in the oil reservoir or by multiple V-belts and sheaves of number and size to insure maximum factor of safety. Drive type shall be determined based primarily on the load on the car, travel, and speed.
- D. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall comply with specified speeds and loads.
- E. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
 - 1. Relief valve shall be externally adjustable and be capable of bypassing the total oil flow without increasing back pressure by more than 10 percent above that required to barely open the valve.
 - 2. Up start and stop valve shall be externally adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
 - 3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
 - 4. Lowering valve and leveling valve shall be externally adjustable fore drop-away speed, lowering speed, leveling speed, and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling when slowdown is initiated.
- F. Power controller shall contain electrical contractor, electro-mechanical switches and thermal overload relays. Mount components in a NEMA 1 enclosure. Logic control system shall be microprocessor based and protected from environmental extremes and excessive vibrations.
- G. Reduced Voltage Starting: Provide a solid state starter to limit current inrush during starting and to provide gradual acceleration of the motor. Motor starting shall not be initiated by mechanical contacts. Starter shall include a current limit adjustment range of 200 percent to 450 percent of the overload adjustment range. Provide an integral fault detection and diagnostic system.

2.06 DOOR OPERATION

A. Door Operation: Provide a direct current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. Direct drive geared operators, AC controlled units with oil checks, or other deviations are not acceptable.

- 1. No Unnecessary Door Operation: Car door shall open only if the car is stopping or a car or hall call, answering a car or hall call at the present position or selected and the next car up.
- 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
- 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
- 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door movement is obstructed for a field programmable time, a buzzer will sound and the doors will close at reduced speed. If the infra-red door protection system detects a person or object while closing, the doors will stop and resume closing after the obstruction has been removed.
- 5. Limited Door Reversal: If the doors are closing and an infra-red beam is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
- 6. Door Open Sentinel: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then open six times to try and correct the fault.
- 7. Door Close Sentinel: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then close six times to try and correct the fault.
- 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- 9. Door Protection Devices: Provide a door protection system using 40 microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen. A mechanical reopening device is not acceptable.

2.07 CAR OPERATING STATION

- A. General: The main car control in each car shall contain the devices required for specific operation mounted in stainless steel No. 4 integral swing return panel requiring no applied faceplate. The panel shall consist of a series of modules, inclined 20 degrees from vertical for optimum viewing and accessibility.
 - 1. The lowest module shall contain the "door open," "door close," and "alarm" buttons and a keyed "emergency stop" switch.
 - 2. Intermediate modules shall contain floor buttons which illuminate when a call is registered and remain illuminated until the call is answered. Raised floor indications and handicap symbols shall be located immediately adjacent to the floor buttons and be fully integrated in the module design. No applied symbols or floor indications or symbols on the buttons shall be permitted.
 - 3. The top module shall contain Phase II firefighters emergency in-car operation service key switch, with instructions, and shall be incorporated into the car operating station.
 - 4. Car station button shall be vandal resistant.
- B. Position Indicator: An electronic dot matrix position indicator inclined 20 degrees from vertical and mounted in a module matching the control panel for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alpha/numeric character corresponding to the landing which the elevator is stopped or passing.
- C. Emergency Light: An emergency light and capacity plate shall be integrated into a module inclined 20 degrees from vertical. Emergency light shall illuminate automatically upon loss of the building's normal power supply.

- D. Emergency Communications System: Provide an emergency communications device mounted in the swing return. Emergency communications device shall comply with ANSI A117.1/Americans with Disabilities Act (ADA) requirements.
 - 1. Emergency phone/device to be programmable.
 - 2. Phone number to be programmed must be staffed 24/7/365. Example: Local 911, or other equivalent service provided by the local municipality.
- E. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- F. Special Accessories:
 - 1. Independent service switch.
 - 2. Inspection switch.
 - 3. Two speed fan/light switch.
 - 4. Telephone jack: Telephone will be provided and installed by the Owner.
 - 5. Certificate frame.

2.08 CONTROLS

- A. Controller: The elevator control system shall be microprocessor based and software oriented and be linked together for purposes of communication by a serial communications link. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by 'up-down" push buttons at each intermediate landing and 'call" push buttons at terminal landings.
 - 1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
 - 2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for the floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.
 - 3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
- B. Microprocessor: Locate the main microprocessor and car controller behind the elevator swing return panel.
 - 1. Microprocessor door operator shall reside in the door operator and control all functions of the elevator door(s).
 - 2. Microprocessor selector shall reside on the car top and contain hall effect transducers that detect magnetic fields. Locate the magnetic fields on a perforated metal tape that runs the length of the hoistway.
- C. Group Operation: Not required.
- D. Provide a key operated switch in the elevator for the purpose of removing the car from normal operation. When the switch is in the "independent service" position, the elevator will bypass all landing calls and answer only car calls. The operator will have complete control over the operation of the car.

2.09 HALL STATIONS

- A. General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction. Faceplates shall be stainless steel No. 4. Provide one set of risers.
 - 1. Each terminal station shall contain one illuminating push button.
 - 2. Each intermediate station shall consist of two illuminating pushbuttons, one for the up direction and one for the down position.
 - 3. Phase I firefighters emergency recall operation service key switch, with instructions, shall be incorporated into the hall station at the designated level.
 - 4. Power Supply Indicator Light: Provide a jewel light indicator with engraved wording "GENERATOR POWER" when the elevator is not operating on normal power.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.
- C. Hall Position Indicator: Not required.

2.10 MISCELLANEOUS ELEVATOR COMPONENTS

- A. Oil Hydraulic Silencer: Install an oil hydraulic silencer (muffler device) at the power unit location. Silencer shall contain pulsation absorbing material inserted in a blowout proof housing arranged for inspecting interior parts without removing unit from oil line. Rubber hose without blowout proof features will not be acceptable.
- B. Vibration Pads: Mount vibration pads under the power unit assembly to isolate the unit from the building structure.
- C. Sound Insulating Panels: When pump and motor are not submerged, provide panels manufactured of reinforced 14 gauge steel with 1 inch (25 mm) thick 1-1/2 pound fiberglass core attached to interior and mounted on all four open sides of the power unit frame.
- D. Sound Isolating Couplings: When pump and motor are not submerged, install a minimum of two couplings in the oil line in the machine room between pump and jack. Verify with manufacturers.
- E. Identification of Equipment: Provide device serial number in minimum 1 inch lettering on the crosshead of the each elevator and on the motor of the each machine.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that hoistway, pit, and machine room are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install system components. Connect equipment to building utilities.
- B. Provide conduit, boxes, wiring, and accessories.
- C. Mount motors on vibration and acoustic isolators, on bed plate and concrete pad. Place on structural supports and bearing plates. Securely fasten to building supports. Prevent lateral displacement.
- D. Accommodate equipment in space indicated.

- E. Install guide rails using threaded bolts with metal shims and lock washers under nuts. Compensate for expansion and contraction movement of guide rails.
- F. Accurately machine and align guide rails. Form smooth joints with machined splice plates.
- G. Coordinate installation of hoistway wall construction.
- H. Install hoistway door sills, frames, and headers in hoistway walls. Grout sills in place. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.
- Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- J. Machine Room Components: Clean and degrease; prime one coat, finish with one coat of enamel.
- K. Adjust equipment for smooth and quiet operation.

3.03 ERECTION TOLERANCES

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1.
- B. Cab Movement on Aligned Guide Rails: Smooth movement, with no objectionable lateral or oscillating movement or vibration.

3.04 FIELD QUALITY CONTROL

- A. Testing and inspection by regulatory agencies will be performed at their discretion.
 - 1. Schedule tests with agencies and notify Owner and Architect.
 - 2. Obtain permits required to perform tests.
 - 3. Document regulatory agency tests and inspections in accordance with the requirements of Section 014000.
 - 4. Perform tests required by regulatory agencies.
 - 5. Furnish test and approval certificates issued by authorities having jurisdiction.
- B. Perform operational tests in the presence of Owner and Architect.
- C. Operational Tests:
 - 1. Test single elevator system by transporting at least five persons up from main floor during a five minute period.

3.05 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- B. Adjust automatic floor leveling feature at each floor to achieve 1/4 inch from flush.

3.06 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components ready for inspection.

3.07 PROTECTION

- A. Do not permit construction traffic within cab after cleaning.
- B. Protect installed products until project completion.
- C. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

3.08 MAINTENANCE

A. Provide a separate maintenance contract for specified maintenance service.

- B. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the elevator manufacturer or original installer.
- C. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.
- D. Elevator Manufacturer/Installer to provide, to the Owner, service and maintenance of the elevator system and components for one year from Date of Substantial Completion.
 - 1. Examine system components monthly. Clean, adjust, and lubricate equipment.
 - 2. Include systematic examination, adjustment, and lubrication of elevator equipment. Maintain hydraulic fluid levels. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original equipment. Replace wire ropes when necessary to maintain the required factor of safety.
- E. Perform work without removing cars during peak traffic periods.
- F. Provide emergency call back service at all hours for this maintenance period.
- G. Maintain an adequate stock of parts for replacement or emergency purposes locally, near the place of the Work. Have personnel available to ensure the fulfillment of this maintenance service, without unreasonable loss of time.

3.09 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failure or malfunctions.
- B. Make a final check of each elevator operation with Owner's personnel present, immediately before Date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION 142010

DIVISION 21– FIRE SUPPRESSION

SECTION 210000 - GENERAL PROVISIONS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 REVIT

- A. The plans, sections and risers were made with REVIT. This program has some limitations on the types of valves, fittings, taps, accessories... that can be show. The contractor should review the specifications and details for the proper type of valves, fittings, taps, accessories... because what is shown on the plans may be the "closest" available within the limitations of REVIT and not exactly what is required by the contract specifications and details.
- B. Mounting heights may have been modified to show elements on the correct floor plan for bidding. Coordinate with the architect and engineer if it is not clear.
- C. Components may be orientated for clarity. Actual components shall be orientated as required by specifications, service requirements or manufacturers recommendations.

1.2 **GENERAL**

- A. The General Conditions, Special Conditions, Supplemental Conditions, Instructions to Bidders, and other Contract Documents apply to this branch of the work as well as to the other branches.
- B. Provide the materials (piping, wiring, conduit, equipment, equipment accessories, etc.) and labor necessary for complete and functioning mechanical systems. The Drawings and Specifications are intended to indicate complete working systems. Provide complete and properly working systems, even if all materials and labor necessary to achieve this are not specifically shown on the Drawings or specified.
- C. The Contractor shall familiarize himself with the work of all other trades, general type construction, and the relationship of his work to other sections. He shall examine all working drawings, specifications and conditions affecting his work. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, verify all dimensions in the field and advise the Engineer of any discrepancy before fabricating or performing any work.
- D. Sprinkler heads shown are to indicate layout patterns and have been coordinated with the architect. Review the documents and provide all additional heads required for compliance with all codes and standards (i.e. obstruction rules, coverage requirements, occupancy classification...). Unless there is a conflict with codes and standards, provide layout shown.
- E. The work shall include complete testing of all equipment and piping at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment.
- F. Perform any necessary temporary work during construction.
- G. Work under this section shall conform to governing codes, ordinances and regulations of the City, County and State.

H. The Contractor shall be responsible for any errors in fabrication, for the correct fitting, installation and erection of the various fire suppression systems.

1.3 VIBRATION ISOLATION

A. Installation of vibration isolation equipment pertaining to fire suppression systems shall be by this Contactor.

1.4 POWDER ACTUATED CONCRETE FASTENERS

- A. Obtain written approval from the structural engineer before using powder-actuated concrete fasteners.
- B. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

1.5 SUSPENSION FROM METAL DECKING

A. Do not use metal decking for suspension of piping. Hang items from top member of joist or provide additional structure to span between top members if needed.

1.6 COORDINATION BETWEEN TRADES

- A. Demand and examine all Drawings and Specifications pertaining to the construction before installing the work described and shown under these Drawings and Specifications. Cooperate with all other Contractors in locating piping, openings, chases and equipment in order to avoid conflict with any other Contractor's work. Give special attention to points where piping must cross ducts or other piping and where piping and conduit must fur into the walls and columns. All work installed above a lay-in ceiling must be coordinated and installed so there is a minimum of 4 inches between the top of the ceiling grid and the bottom of the installation.
- B. Make known to other trades intended positioning of materials and intended order of work. Determine intended position of work of other trades and intended order of installation.

1.7 DISCREPANCIES

A. If any discrepancies occur between the accompanying Drawings and these Specifications and Drawings and Specifications covering other Contracts, report such discrepancies to the Architect/Engineer far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of piping and equipment not installed in accordance with the above instructions, and which interferes with work and equipment of other Contractors.

1.8 EXISTING PIPE AND SERVICES

- A. Existing piping and services are located as accurately as possible from available information, but it shall be the Contractor's responsibility to locate, determine exact elevations and make required connections to such lines and services in manner approved by the Architect/Engineer.
- B. Maintain in operating condition active utilities encountered in the utility installation. Repair to the satisfaction of the Architect/ Engineer and the Owner any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.

1.9 CONTINUOUS OPERATION AND CUTOVER

A. To facilitate the continuous operation of the existing utilities, no utility service shall be tapped into without prior notification of 48 hours to and approval received from the designated authority of the utility company.

1.10 ASBESTOS

A. If during the course of his work the Contractor observes the existence of asbestos, or asbestos-bearing materials, the Contractor shall immediately terminate further work on the project and notify the Owner of the condition. The Owner will, after consultation with the Engineer, determine a further course of action.

1.11 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Extend all grease fittings to an accessible location.

1.12 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.13 FIRE SUPPRESSION INSTALLATIONS

- A. Coordinate fire suppression equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements. Field verify existing conditions and all required measurements before fabricating any piping or equipment.
- C. Arrange for chases, slots, and openings in other building components to allow for fire suppression installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Coordinate the cutting and patching of building components to accommodate the installation of fire suppression equipment and materials.
- G. Where mounting heights are not detailed or dimensioned, install fire suppression services and overhead equipment to provide the maximum headroom possible.
- H. Install fire suppression equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

- I. Coordinate the installation of fire suppression materials and equipment above ceilings with suspension system, light fixtures, and other installations.
- J. Coordinate connection of fire suppression systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- K. Do not install fire suppression work where it will interfere with work of other trades.
- L. Do not install fire suppression work under HVAC terminal units above suspended ceilings, such as heat pump units, air handling units, variable volume units, coils, etc.
- M. Do not install fire suppression work where it will interfere with access doors in ductwork.
- N. Do not install fire suppression work where it will interfere with access to control panels on mechanical and/or electrical equipment.
- O. Do not install fire suppression work where it will interfere with access space around mechanical and electrical equipment. Do not install piping where it will interfere with removal of HVAC coils, filters or fan shafts.
- P. Do not install piping so close to ceiling that ceiling tiles in accessible ceilings cannot be removed without damaging them.
- Q. Do not install fire suppression work over the top of electrical equipment. Maintain minimum distances away from electrical equipment as required by the Electric Code.

1.14 EXCAVATION, TRENCHING AND BACKFILLING

- A. Photographs: The contractor shall photograph all underground utilities before backfilling. Photographs shall be oriented and labeled so that the locations, all crossings and depths of the utilities can be determined from the photographs.
- B. General: Excavate in accordance with requirements of Specification Section "EARTHWORK" and requirements of this Section. Lay the pipe in open trench except when the Architect/Engineer gives written permission for tunneling. Open the trench sufficiently ahead of pipe laying to reveal obstructions. Maintain easy access to fire hydrants by fire fighting apparatus. Provide trench crossing as necessary to accommodate public travel.
- C. Provide trench crossing as necessary to accommodate public travel.
- D. Separate Trenches: Unless otherwise shown or requested, provide separate trenches for sewers, water lines and gas lines, respectively, with a minimum of 3' of undisturbed earth between trenches. In locations such as close to building, where separate trenches for sewers and water lines are impracticable, lay the water pipe on a solid shelf at least 18" above the top of the sewer. Always place gas lines in a separate trench from electrical lines.
- E. Width of Trench: Excavate trenches of sufficient width for proper installation of work. When the depth of backfill over sewer pipe exceeds 10', keep the trench at the level of the top of the pipe as narrow as possible.
- F. Sheeting and Bracing: Sheet and brace trenches as necessary to protect workmen and adjacent structures. Comply with local regulations or, in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and prevent injurious caving. When ordered in writing by the Architect/ Engineer, leave sheeting in place and the Contract will be adjusted (See General Conditions): cut off such sheeting not to be removed at least 3' below finished grade.

- G. Water Removal: Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper jointing of pipes. Conduct the discharge from trench dewatering to drains or natural discharge channels.
- H. Disposition of Utilities: Observe rules and regulations governing the respective utilities in executing work under this heading. Protect active utilities from damage or remove in accordance with written instructions of the Architect/Engineer (See General Conditions). Plug, cap or remove inactive and abandoned utilities encountered in trenching operations. In absence of specific requirements, plug or cap such utility line at least 3' from utility line to be installed or as required by local regulations.
- I. Rock Excavation: Materials to be excavated shall include earth and any other material including rock encountered within the limits of trench excavation for the utilities to the depth and extent indicated on the drawings and herein specified. In case of any change ordered by the Owner or Architect/Engineer in the quantity of excavation, the contract price will be adjusted by unit price or as described under Excavation, Filling and Grading of Division Site Work of these specifications. The term "rock" as used is defined to be hard material in nature that cannot be dislodged from its bed and removed therefrom without blasting or drilling. Any other is "earth" insofar as removal of the material to be excavated is concerned.
 - 1. Allowance for Additional Rock Excavation: In addition to the rock removal specified in the preceding paragraph, include in the Contract Price an additional ten (l0) cubic yards of trench rock removal by mechanical means. If more or less additional rock removal is required due to changes in routing or in elevations of underground utilities authorized in writing, the Contract Price will be adjusted via unit prices.
- J. Blasting: See Specification Section "EARTHWORK" to see if blasting is allowed. If blasting is allowed, obtain written approval of method from Architect/Engineer before proceeding with rock excavation.
- K. Trench Bottoms: Lay all pipe, unless otherwise noted or detailed, in undisturbed earth on at least 4" of #9 crushed stone, or other approved grillage. Bedding shall be in place and graded before pipe is installed.
- L. Special Supports: Whenever, in the option of the Architect/Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting sewers or other utilities and appurtenances specified in this section, provide special support as the Architect/Engineer may direct and the Contract Price will be adjusted. (See General Conditions).
- M. Tree Protection: Exercise care to protect the roots of trees to remain. Within the branch spread of such trees, perform trenching by hand. Open the trench only when the utility can be installed immediately, prune injured roots cleanly and backfill as soon as possible. Perform this work under the direction of the Architect/Engineer.
- N. Backfilling: Inspect and test piping and record locations of pipe lines and appurtenances before backfilling.
- O. Trenches Under Floor Slabs: Backfill under floor slab on grade to a point 5'-0" outside of perimeter building wall with fill as specified in Division Section "EARTHWORK". Remove excess excavation materials from the site daily unless otherwise instructed.
- P. Trenches in Other Areas: Backfill with materials in accordance with Specification Section "EARTHWORK". Compact backfill thoroughly with a heavy tamper.
- Q. The Contractor, at his option, may backfill the remaining depth of the trench from 12" above top of piping to 12" below finished grade with sand, wash gravel, or fine rock chat. The remaining depth of the trench would then be backfilled as specified in the preceding specification.

1.15 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.

1.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

1.17 WORKING DRAWINGS

- A. Scale of drawings is approximate. Do not scale the drawings to determine locations of fire suppression work. Exact locations, dimensions and elevations shall be governed by field conditions. Make field measurements of building before fabricating or installing equipment or materials.
- B. Drawings are based on physical dimensions of one or more manufacturer's equipment. Other approved equipment shall be of such dimensions that it can be readily installed in available space, leaving ample clearance for proper maintenance.
- C. Intent of drawings is to show systems and sizes. Drawings do not necessarily show all required offsets. Work shall be installed to conform with space limitations. Offsets, transitions, fittings, etc., shall be provided as part of the Contract where required to attain this objective.

1.18 PAINTING

- A. Paint the following items.
 - 1. Exposed fire suppression piping, valve bodies and fittings bare and insulated, including hangers, platforms, etc.
 - 2. "Exposed" shall mean exposed to view, such as, in mechanical spaces, tunnels, on roofs and in rooms with no suspended ceilings.
- B. Painting shall be done in accordance with the "Painting" section of the specifications unless otherwise specified under other sections of the specifications,
- C. Do not paint aluminum and stainless steel equipment, motor and identification plates, tags, etc.
- D. Do not paint piping concealed in walls or above suspended ceilings.

1.19 DEBRIS

A. Remove from the site any debris and dirt caused by the work. Maintain the premises in a clean and orderly condition.

1.20 PROTECTION OF EQUIPMENT AND MATERIALS

A. Provide suitable protection from dampness damage, dirt, etc., for equipment and materials during construction and until final acceptance by the Owner. Keep ends of piping and ductwork capped off when work on them is not in progress. Such protection shall be by a means acceptable to the Architect/Engineer.

1.21 CLEANING UP

A. After completion of the work and before final acceptance of the work, thoroughly clean equipment and materials and remove foreign matter such as grease, dirt, labels, stickers, etc., from the exterior of piping, equipment and associated fabrications.

1.22 EQUIPMENT CONNECTIONS

- A. Make connections to equipment furnished by others whenever such equipment is shown on any part of the drawings or mentioned in any section of the specifications.
- B. Verify equipment locations and the sizes, number, locations, and types of connections to be made before installation of any such equipment.

1.23 EQUIPMENT INSTALLATION INSTRUCTIONS

A. Install fire suppression piping and equipment in strict accordance with manufacturer's recommendations. Provide equipment accessories necessary for proper operation or recommended by the manufacturer, even if such accessories are not shown on the drawings or mentioned in the specifications.

1.24 PERMITS, CODES AND APPROVALS

- A. Permits. Obtain and pay for the permits and licenses necessary for the complete mechanical systems from the authorities governing such work.
- B. Codes. Installation shall be in accordance with applicable codes and regulations, including but not limited to the following:
 - 1. City or County Building Inspector
 - 2. National and Local Electric Codes
 - 3. Kentucky Building Code and its referenced codes
 - 4. Kentucky State Fire Marshal
 - 5. Local Fire Codes
 - 6. Local Building Inspections
- C. Approvals. All work must be approved by the Architect/Engineer before final payment is made.

1.25 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. When making a shop drawing submittal for materials and/or equipment of a different manufacturer than that specified, it shall be understood and agreed that such substitution if approved will be made without cost to the Owner, regardless of changes in connections, spacing, electrical service, etc.

1.26 WORKMANSHIP

A. Work shall be performed by mechanics skilled in their respective trades and shall present appearance typical of best trade practice. Work not installed in this manner shall be repaired, removed or replaced, or otherwise remedied as directed by the Architect/Engineer.

1.27 RECORD DRAWINGS

A. Keep accurate record of deviations from drawings, particularly where work is concealed. Submit one (1) set of drawings marked to show changes when work is completed.

1.28 SUPERVISION

- A. The Contractor shall personally supervise the work or have a competent superintendent, satisfactory to the Architect/Engineer and Owner on the work at all times during progress with full authority to act.
- B. The Contractor shall lay out his work and be responsible for any necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so. Work at the site of the project shall be observed by the Architect/Engineer or his representative.
- C. Final Inspection. At the time of final inspection of the work performed under this Contract, systems shall be complete in every respect and in perfect operating condition. Surplus materials of every character resulting from work of this section shall have been removed. Any defect discovered in the utilities subsequent to this inspection shall have been corrected.

1.29 STRUCTURAL RESPONSIBILITY

- A. The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing, or weakening. No structural member shall be cut or otherwise weakened in any manner without the written consent of the Architect/Engineer.
- B. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Owner or Architect/Engineer, without cost to either the Owner or the Architect/ Engineer.

1.30 OPENINGS

- A. This Contractor shall be responsible for the openings he may require in floors, walls, roof or ceilings of any type of new or existing construction whether or not shown on the Architectural, Structural or Fire Suppression Drawings.
- B. Openings that have been shown on the Architectural and/or Structural Drawings will be provided under other Divisions; however, the responsibility for the correct size and location of such openings shall be that of this Contractor.

- C. Openings that have not been shown on the Architectural and/or Structural Drawings shall be provided by this Contractor.
- D. Review and conform to all structural requirements as detailed or specified in the Structural drawings and specifications.

1.31 CUTTING, FITTING AND PATCHING

- A. Before doing any cutting or drilling, Contractor shall obtain permission from the Architect/Engineer and shall follow his instructions as to how proposed cutting or drilling is to be done.
- B. Do any cutting, patching, drilling of masonry, steel, wood or iron work and any fitting necessary for the proper installation of apparatus and materials included in these specifications or governed thereby.
- C. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- D. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- E. Coordinate with the Structural Engineer BEFORE drilling, cutting, notching, etc., any new or existing structural members. Obtain written permission from Structural Engineer before doing such work. Locations and sizes of openings and methods of cutting or drilling such openings must be approved in advance by the Structural Engineer. Positively identify exact locations of reinforcing bars or tension cables in structural members by X-raying or other methods approved by the Structural Engineer if required by the Structural Engineer.
- F. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.
- G. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
- H. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
- I. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
- J. Comply with requirements of applicable Sections of Division 21 where cutting and patching requires excavating and backfilling.
- K. The patching and finishing shall be done in a workmanlike manner to the satisfaction of the Architect/Engineer.
- L. Patch any openings in existing floors, walls, ceilings or roof, left by removal of existing fire suppression work.
- M. Review and conform to all structural requirements as detailed or specified in the Structural drawings and specifications.

1.32 CONNECTIONS TO EXISTING UTILITY MAINS

- A. Make arrangements with the utility companies for connection to water service. The entire utilities installations are included under this contract, including payment of all utility company charges, and including the points of tie-ins to utility company mains. Where meters, regulators, vaults, etc., are being furnished or furnished and installed by the utility companies, the Contractor shall pay any fees and charges connected with the particular installation such as tap-in charges, meter charges, installation charges, etc.
- B. Install meters, regulators, etc. furnished by the utilities companies.
- C. Pipe up meters in accordance with utility company's requirements. Provide meters, regulators, shutoff valves, bypass valves, test plugs, piping, fittings and any other devices required by the utility company. In addition, provide any devices required by the Drawings.

1.33 TEMPORARY UTILITIES

A. In any installation that requires deletion of existing services to install new services, a means of providing temporary service for the intermediate period shall be provided. The means of providing temporary service is to be reviewed and revised as required by the Engineer. This means of providing temporary service is to include but not limited to piping, valves, insulation, restraints & thrust blocks and all other components required to make a temporary service operational to a level equal to the existing utility service.

1.34 RESTORATION OF SURFACES

A. Each Contractor shall restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, shrubs, and other items damaged or removed by his operations that are outside of the Limit of Site boundaries. Replacement and repairs shall be in accordance with good construction practice and shall match material employed in the original construction of the item to be replaced.

1.35 SHOP DRAWINGS AND OTHER REQUIRED SUBMITTALS

- A. Comply with requirements listed in Division 1 Section SUBMITTAL PROCEDURES and the following paragraphs.
- B. Definitions
 - 1. Action Submittals: See Division 1 Section "SUBMITTAL PROCEDURES".
 - 2. Informational Submittals: See Division 1 Section "SUBMITTAL PROCEDURES".
- C. Submittals may be submitted in electronic format. Submit in accordance with requirements in Division 1 Section "SUBMITTAL PROCEDURES" and requirements of this Section.
- D. Prepare and submit to the Architect/Engineer for review, shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc., and any other data required.
- E. Submittal data shall have the stamp of approval of the General Contractor to show that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval will be returned for proper resubmission.
- F. No roughing-in, connections, etc., shall be done until acceptable shop drawings are in the hands of the Contractors. It shall be the responsibility of the Contractor to obtain acceptable shop drawings and to make connections, etc., in the neatest and most workmanlike manner possible.

- G. Submittal data must be complete for each piece of equipment. Partial or incomplete data will not be processed.
- H. Architect/Engineer's review of shop drawings the applies only to general design, arrangement, type, capacity and quality. Such approval does not apply to quantities, dimensions, connection locations, etc. In these cases, the Contractor alone shall be responsible for furnishing the proper quantity of the equipment and/or materials required for seeing that the equipment fits the available space in a satisfactory manner and that piping, electrical and other connections are suitably located.
- I. The Architect's/Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for deviations from drawings or specifications unless he has, in writing, called the Architect's/Engineer's attention to such deviation at the time of submission and secured his written acceptance nor shall it relieve him from responsibility for error in shop drawings or schedules.
- J. Submittal data must be complete and acceptable before project is accepted.

1.36 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. This Contractor shall prepare three loose-leaf, bound brochures, entitled "Fire Suppression Equipment Operation and Maintenance Data." Mark identification on both front and spine of each binder. Each binder shall be a heavy duty 3-ring, vinyl-covered binder with pocket folders for folded sheet information. Each binder cover and spline shall have the project name (as listed on the drawings) and what is in the binder. If more than one binder is provided the cover and spline shall be marked with "Volume? of?". Binders shall be properly indexed (thumb- tabbed). Information shall be filed under applicable specification section number.
- B. Each brochure shall contain the following information:
 - 1. Name and address of Consulting Engineer, Contractor, and index of equipment, including vendor (name and address).
 - 2. Complete brochures, descriptive data and parts list, etc., on each piece of equipment, including all approved shop drawings.
 - 3. Complete maintenance and operating instructions, prepared by the manufacturer, on each major piece of equipment.
- C. All brochures shall be submitted to the Architect/Engineer or his representative prior to final inspection of the building.
- D. In addition to hard copy, provide electronic pdf copy of manuals. Electronic pdf copy shall be bookmarked identical to above instructions for hard copy.

1.37 OWNER INSTRUCTION

- A. Conduct a minimum of a full-day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of fire suppression equipment and systems.
- B. Engage factory-authorized service representatives for the following equipment to train Owner's maintenance personnel:
- C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Review data in the operation and maintenance manuals.
- D. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, security, safety, efficiency and similar features of the systems.

E. Video the instruction sessions and turn over video to the Owner. The video shall be provided to the owner in electronic format acceptable to the owner.

1.38 MAINTAINING EXISTING SERVICES

A. Properly make all temporary connections that may be necessary to continue these services in a safe and substantial manner until the permanent services are activated. Upon completion, remove all temporary work, and completely restore all areas that may be affected.

1.39 INTERRUPTION OF EXISTING FIRE SUPPRESSION SERVICES

- A. In general, do not interrupt fire suppression services to other campus buildings. If services must be interrupted (for making temporary connections, for changing over from existing to new, or for making new connections to existing systems, for example) then do such work at the times designated by the Owner.
- B. Schedule this work in advance with the Owner. Perform work on premium time if required to do so by the Owner.
- C. At any time the existing building services are interrupted, the Contractor shall work continuously until the permanent services are restored.

1.40 OWNER OCCUPANCY

A. Full Owner Occupancy: The Owner will occupy the site and buildings surrounding construction area during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work to minimize interference with the Owner's operations. Perform portions of work on premium time if required to do so by the Owner.

1.41 **DEMOLITION**

- A. Disconnect, demolish, and remove existing fire suppression systems, equipment, and components indicated to be removed.
- B. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
- C. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
- D. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- E. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- F. All existing suppression work (such as piping, valves, etc.) shall become the property of the Contractor and shall be removed from the job site.
- G. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- H. Remove or relocate existing suppression work that interferes with new work of any kind.

- I. The Drawings show existing work to the extent possible. However, all existing work may not be shown. Remove or relocate any existing work that interferes with new work even if it is not shown on the Drawings.
- J. Remove existing work that does not have to remain in service. Relocate existing work that has to remain in service, as required to avoid interference with new work.
- K. Remove or relocate existing electrical work that interferes with new suppression work, if such work is not indicated to be removed or relocated on the Electrical Drawings. Remove work that does not have to remain in service. Relocate work that has to remain in service, as required to avoid interference with new work.
- L. Existing work serving the floors above or below shall remain in service.

1.42 LICENSE REQUIRED

A. Contractors installing fire suppression work must be a licensed Fire Suppression Contractor. Submit proof of licensing.

1.43 PROFESSIONAL ENGINEER QUALIFICATIONS

A. When the term "professional engineer", or "qualified professional engineer" is used anywhere in these specifications it shall mean a person who is licensed to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 FIRESTOPPING

- A. Provide seals for any opening through any walls, floors, or ceilings used as passage for plumbing components.
- B. General: Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings as established by testing identical assemblies per ASTM E 814 by Underwriters' Laboratories, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction. Sealant shall provide protection equal or exceeding the fire resistance rating of fire rated walls, partitions, ceilings or floors. Use two-part or one part sealants as required to meet required fire resistance ratings.
- C. Foamed-In-Place Fire-Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around cables, conduit, pipes and similar penetrations through walls and floors.
- D. One-Part Fire-Stopping Sealant: One part elastomeric sealant formulated for use in a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors.
- E. Intumescent Fire-Stopping Sealant: A one-part, acrylic sealant that expands when exposed to heat.
- F. Firestop Compound: Trowelable compound for large openings
- G. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - 1. Foamed-in-Place Fire-Stopping Sealant:

- a. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
- b. "Pensil 851": General Electric Co.

2. One-Part Fire-Stopping Sealant:

- a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
- b. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
- c. "RTV 7403"; General Electric Co.
- d. "Fyre Putty"; Standard Oil Engineered Materials Co.
- e. "FS 601"; Hilti Inc.
- f. "FS 611A"; Intumescent Sealant; Hilti Inc.
- g. "FS 635"; Hilti Inc.
- H. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials to fill openings around plumbing services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

2.2 ACCESS UNITS

- A. General. The work of this article is limited to the provisions for access through other work for access to fire suppression work, and does not include internal access provisions (within the fire suppression work). In general and where possible, furnish or furnish-and-mount required access units in other trades' work prior to their work, so that cutting and patching for the subsequent installation of such access units will not be required. In occupied spaces, provide finished access units of the maximum concealment type, including locks where appropriate, and matching access units provided in the same expanse of finish (for non-fire suppression access, if any).
- B. The scope of access units to be furnished or provided as fire suppression work includes those units indicated on the fire suppression drawings or specified in Division 21 sections, and those additional units required for adequate access to fire suppression work and not shown or specified individually.
- C. Access Doors. Standard welded-steel construction, 16-gage frames and 14 gage door panels, 175 degree concealed spring hinges, rust-inhibitive prime coat, flush cam lock (for screw-driver operation where keyed lock is not required), recessed to receive applied finish where applicable (such as in concealed spline ceilings).
- D. Removable Access Plates. Where only hand access is sufficient, provide removable plate-type access unit, or minimum size which will facilitate the required access. Provide units of the type, style, design, material and finish appropriate for the location and exposure in each instance. In exposed surfaces of occupied spaces provide round plate units, flush floor units and frameless low-profile wall units, primed-for-paint in painted surfaces and polished chrome or stainless steel finish in other surfaces.
- E. Access Thru Fire Rated Walls or Ceilings. Where access doors or plates are required in fire rated partitions or ceilings, provide U.L. listed "B" Label doors or plates rated for 1-1/2 hours. Furnish doors with automatic closers and key operated latches that latch automatically when door closes.

2.3 FLASHING:

- A. General: Provide flashings from the following listing for each penetration of fire suppression systems through roofs or waterproof membranes. Select appropriate flashing method for the type of roof used. Flashing shall be in accordance with roofing manufacturer's recommendations.
- B. Copper Flashing: Provide cold-rolled sheet copper, complying with ANSI/ASTM B 370, weighing 16 oz. per sq. ft. (0.0216" thick), except as otherwise indicated.

- C. Lead Flashing: Provide sheet lead complying with FS QQ-L-2201, Grade B; formed from common desilverized pig lead, complying with ANSI/ASTM B 29; weighing 4.0 lbs. per sq. ft., except as otherwise indicated.
- D. Bituminous Coating: FS TT-C-494, or MIL-C-18480, or SSPC-paint 12, cold-applied solvent-type bituminous mastic coating for application in dry film thickness of 15 mils per coat.
- E. Laminated Sheet Flashing: Bottom laminate of heavy-duty nonplasticized chlorinated polyethylene (CPE) synthetic elastomer, with top laminate of built-up roofing (BUR) sheet material; weighing 8 oz. per sq. ft.
- F. Manufacturer's Recommendations: Except as otherwise shown or specified, comply with recommendations and instructions of manufacturer of sheet metal being installed.
- G. Coat back side of lead flashings where in contact with concrete and other cementitious substrates, by painting surface in area of contact with heavy application of bituminous coating, or by other permanent separation as recommended by manufacturer of metal.
- H. On vertical surfaces, lap flashings minimum of 3".
- I. On vertical surfaces, for slopes of not less than 6" in 12", lap unsealed flashings minimum of 6".
- J. For embedment of metal flashing flanges in roofing or composition flashing or stripping, extend flanges minimum of 6" for embedment.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Specification Section "Cast-in-Place Concrete."

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Specification Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.3 GROUTING

- A. Mix and install grout for fire suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 210000

SECTION 21 0517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, LLC.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2. Zurn Industries, LLC.
- B. Description: Manufactured, Dura-coated or Duco-coated or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, LLC.
 - 2. CALPICO, Inc.
 - 3. <u>Metraflex Company (The)</u>.

B. Description:

- 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
- 2. Designed to form a hydrostatic seal of 20 psig (137 kPa) minimum.
- 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
- 4. Pressure Plates: Stainless steel.
- 5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Sherwin-Williams Company (The).
 - c. <u>The Dow Chemical Company</u>.
 - 2. <u>Verify sealant has a VOC</u> content of 250 g/L or less.
 - 3. <u>Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."</u>
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - 2. <u>Verify sealant has a VOC</u> content of 250 g/L or less.
 - 3. <u>Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."</u>
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Smooth-On.
 - 2. <u>Verify sealant has a VOC</u> content of 250 g/L or less.
 - 3. <u>Verify sealant complies with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

- Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 2. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Use silicone sealant to seal around the outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Stack-sleeve fittings.
 - b. Piping NPS 6 (DN 150) and Larger: Stack-sleeve fittings.
 - 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 **DEFINITIONS**

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>BrassCraft Manufacturing Co.; a Masco company</u>.
 - 2. <u>Dearborn Brass</u>.
 - 3. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Piping: One-piece, floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 210518

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Two-piece ball valves with indicators.
 - 2. Bronze butterfly valves with indicators.
 - 3. Iron butterfly valves with indicators.
 - 4. Check valves.
 - 5. Bronze OS&Y gate valves.
 - 6. Iron OS&Y gate valves.
 - 7. NRS gate valves.
 - 8. Indicator posts.
 - 9. Trim and drain valves.

1.3 **DEFINITIONS**

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.

- 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Main Level: HAMV Fire Main Equipment.
 - a. Level 1: HCBZ Indicator Posts, Gate Valve.
 - b. Level 1: HLOT Valves.
 - 1) Level 3: HLUG Ball Valves, System Control.
 - 2) Level 3: HLXS Butterfly Valves.
 - 3) Level 3: HMER Check Valves.
 - 4) Level 3: HMRZ Gate Valves.
 - 2. Main Level: VDGT Sprinkler System & Water Spray System Devices.
 - a. Level 1: VQGU Valves, Trim and Drain.
- B. Sdource Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- C. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B1.20.1 for threads for threaded-end valves.
 - 3. ASME B31.9 for building services piping valves.
- D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- E. NFPA Compliance: Comply with NFPA 24 for valves.
- F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 (DN 50) and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. <u>NIBCO INC</u>.
 - 2. <u>Victaulic Company</u>.

B. Description:

- 1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
- 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 3. Body Design: Two piece.
- 4. Body Material: Forged brass or bronze.
- 5. Port Size: Full or standard.
- 6. Seats: PTFE.
- 7. Stem: Bronze or stainless steel.
- 8. Ball: Chrome-plated brass.
- 9. Actuator: Worm gear or traveling nut.
- 10. Supervisory Switch: Internal or external.
- 11. End Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
- 12. End Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Description:
 - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
 - 2. Minimum: Pressure rating: 175 psig (1200 kPa).
 - 3. Body Material: Bronze.
 - 4. Seat Material: EPDM.
 - 5. Stem Material: Bronze or stainless steel.
 - 6. Disc: Bronze with EPDM coating.
 - 7. Actuator: Worm gear or traveling nut.
 - 8. Supervisory Switch: Internal or external.
 - 9. Ends Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
 - 10. Ends Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Anvil International, Inc.
 - 2. <u>Fivalco Inc</u>.
 - 3. Globe Fire Sprinkler Corporation.

- 4. Kennedy Valve; a division of McWane, Inc.
- 5. NIBCO INC.
- 6. Tyco Fire & Building Products LP.
- 7. <u>Victaulic Company</u>.

B. Description:

- 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
- 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 3. Body Material: Cast or ductile iron.
- 4. Seat Material: EPDM.
- 5. Stem: Stainless steel.
- 6. Disc: Ductile iron, and EPDM or SBR coated.
- 7. Actuator: Worm gear or traveling nut.
- 8. Supervisory Switch: Internal or external.
- 9. Body Design: Lug or wafer.

2.5 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. <u>Anvil International, Inc.</u>
 - 2. <u>Globe Fire Sprinkler Corporation</u>.
 - 3. Kennedy Valve; a division of McWane, Inc.
 - 4. <u>Mueller Co.</u>; Water Products Division.
 - 5. NIBCO INC.
 - 6. Reliable Automatic Sprinkler Co., Inc.
 - 7. <u>Tyco Fire & Building Products LP.</u>
 - 8. Victaulic Company.
 - 9. Viking Corporation.
 - 10. Watts Water Technologies, Inc.

B. Description:

- 1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
- 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 3. Type: Single swing check.
- 4. Body Material: Cast iron, ductile iron, or bronze.
- 5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
- 6. Clapper Seat: Brass, bronze, or stainless steel.
- 7. Hinge Shaft: Bronze or stainless steel.
- 8. Hinge Spring: Stainless steel.
- 9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. <u>Milwaukee Valve Company</u>.
 - 2. <u>NIBCO INC</u>.

3. <u>United Brass Works, Inc.</u>

B. Description:

- 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
- 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 3. Body and Bonnet Material: Bronze or brass.
- 4. Wedge: One-piece bronze or brass.
- 5. Wedge Seat: Bronze.
- 6. Stem: Bronze or brass.
- 7. Packing: Non-asbestos PTFE.
- 8. Supervisory Switch: External.
- 9. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Clow Valve Company; a division of McWane, Inc.
 - 2. Hammond Valve.
 - 3. <u>Kennedy Valve</u>; a division of McWane, Inc.
 - 4. <u>Mueller Co.</u>; Water Products Division.
 - 5. NIBCO INC.
 - 6. <u>Victaulic Company</u>.
 - 7. Watts Water Technologies, Inc.

B. Description:

- 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
- 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 3. Body and Bonnet Material: Cast or ductile iron.
- 4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- 5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- 6. Stem: Brass or bronze.
- 7. Packing: Non-asbestos PTFE.
- 8. Supervisory Switch: External.
- 9. End Connections: Flanged.

2.8 NRS GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Clow Valve Company; a division of McWane, Inc.
 - 2. Kennedy Valve; a division of McWane, Inc.
 - 3. <u>Mueller Co.; Water Products Division.</u>
 - 4. NIBCO INC.
 - 5. <u>Victaulic Company</u>.
- B. Description:

- 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
- 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- 3. Body and Bonnet Material: Cast or ductile iron.
- 4. Wedge: Cast or ductile iron with elastomeric coating.
- 5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- 6. Stem: Brass or bronze.
- 7. Packing: Non-asbestos PTFE.
- 8. Supervisory Switch: External.
- 9. End Connections: Flanged.

2.9 INDICATOR POSTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. <u>Clow Valve Company; a division of McWane, Inc.</u>
 - 2. Kennedy Valve; a division of McWane, Inc.
 - 3. Mueller Co.; Water Products Division.
 - 4. NIBCO INC.

B. Description:

- 1. Standard: UL 789 and FM Global standard for indicator posts.
- 2. Type: Pit.
- 3. Base Barrel Material: Cast or ductile iron.
- 4. Extension Barrel: Cast or ductile iron.
- 5. Cap: Cast or ductile iron.
- 6. Operation: Wrench.

2.10 TRIM AND DRAIN VALVES

A. Ball Valves:

- 1. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Conbraco Industries, Inc.; Apollo Valves.</u>
 - b. FNW; Ferguson Enterprises, Inc.
 - c. <u>Jomar International, LTD</u>.
 - d. <u>Kitz Corporation</u>.
 - e. <u>Metso Automation USA Inc.</u>
 - f. <u>Milwaukee Valve Company</u>.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Tyco Fire & Building Products LP.
 - j. <u>Victaulic Company</u>.
 - k. Watts Water Technologies, Inc.

2. Description:

- a. Pressure Rating: 175 psig (1200 kPa).
- b. Body Design: Two piece.

- c. Body Material: Forged brass or bronze.
- d. Port size: Full or standard.
- e. Seats: PTFE.
- f. Stem: Bronze or stainless steel.
- g. Ball: Chrome-plated brass.
- h. Actuator: Handlever.
- i. End Connections for Valves NPS 1 (DN 25) through NPS 2-1/2 (DN 65): Threaded ends.
- j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2 (DN 32 and DN 65): Grooved ends.

B. Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. NIBCO INC.
 - b. <u>United Brass Works, Inc.</u>
- 2. Description:
 - a. Pressure Rating: 175 psig (1200 kPa).
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:

- 1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for application of valves in fire-suppression water-service piping outside the building.
- 2. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal hanger-shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
- C. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Copper Pipe and Tube Hangers:
 - 1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Cooper B-line</u>; brand of Eaton, Electrical Sector.
 - b. Flex-Strut Inc.
 - c. Unistrut; Atkore International.
 - d. Wesanco, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 8. Metallic Coating: Pregalvanized G90 (Z275).
- B. Non-MFMA Manufacturer Metal Framing Systems:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Anvil International/Smith-Cooper International; Tailwind Capital, LLC.</u>
 - b. <u>Carpenter & Paterson, Inc.</u>
 - c. PHD Manufacturing, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
 - 5. Channel Width: Select for applicable load criteria.
 - 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 8. Metallic Coating: Pregalvanized G90 (Z275).

2.5 THERMAL HANGER-SHIELD INSERTS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. National Pipe Hanger Corporation.
 - 2. Pipe Shields Inc.
 - 3. <u>Rilco Manufacturing Co., Inc.</u>
- B. Insulation-Insert Material: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi (688-kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hilti, Inc
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC.
- B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Cooper B-line; brand of Eaton, Electrical Sector.</u>
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 2. Indoor Applications: Stainless steel.
 - 3. Outdoor Applications: Stainless steel.

2.7 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.8 MATERIALS

- A. Aluminum: ASTM B221 (ASTM B221M).
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.
- D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes

in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

- 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm)
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- G. Use thermal hanger-shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Comply with NFPA requirements.
- K. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. C-Clamps (MSS Type 23): For structural shapes.
 - 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- L. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

- 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Equipment labels.
- 2. Warning signs and labels.
- 3. Warning tape
- 4. Pipe labels.
- 5. Stencils.
- 6. Valve tags.
- 7. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- C. Valve-numbering scheme.
- D. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Brady Corporation</u>.
 - b. Brimar Industries, Inc.
 - c. <u>Carlton Industries, LP</u>.
 - d. Seton Identification Products; a Brady Corporation company.
 - 2. Material and Thickness: Brass, 0.032 inch (0.8 mm) thick, with predrilled or stamped holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and

- proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 6. Fasteners: Stainless steel rivets or self-tapping screws.
- 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Brady Corporation</u>.
 - b. Brimar Industries, Inc.
 - c. <u>Carlton Industries, LP</u>.
 - d. <u>Seton Identification Products; a Brady Corporation company.</u>
- 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, with predrilled holes for attachment hardware.
- 3. Letter and Background Color: As indicated for specific application under Part 3.
- 4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F (71 deg C).
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 7. Fasteners: Stainless steel rivets or self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Brady Corporation</u>.
 - 2. <u>Brimar Industries, Inc.</u>
 - 3. Carlton Industries, LP.
 - 4. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger

lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 WARNING TAPE

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Brady Corporation</u>.
 - 2. Brimar Industries, Inc.
 - 3. <u>Seton Identification Products; a Brady Corporation company.</u>
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch (0.12 mm).
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F (70 deg C).
- G. Minimum Width: 4 inches (100 mm).

2.4 PIPE LABELS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Brady Corporation</u>.
 - 2. Brimar Industries, Inc.
 - 3. <u>Carlton Industries, LP</u>.
 - 4. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:

- 1. Pipe size.
- 2. Flow-Direction Arrows: Include flow-direction arrows on [main] distribution piping. Arrows may be either integral with label or applied separately.
- 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

- A. Stencils for Piping:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brimar Industries, Inc.
 - b. <u>Craftmark Pipe Markers</u>.
 - c. Marking Services Inc.
 - 2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
 - 3. Stencil Material: Aluminum, brass, or fiberboard.
 - 4. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
 - 5. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.
 - 6. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Brady Corporation</u>.
 - 2. <u>Brimar Industries, Inc.</u>
 - 3. <u>Carlton Industries, LP.</u>
 - 4. <u>Seton Identification Products; a Brady Corporation company.</u>
- B. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.04 inch (1.0 mm) thick, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass S-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

2.7 WARNING TAGS

A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1. <u>Brady Corporation</u>.
- 2. Brimar Industries, Inc.
- 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Preprinted accident-prevention tags, of plasticized card stock.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of fire-suppression equipment.
- B. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-red background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. (2 m) of clearance.

C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe-Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. (1 m) of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.
 - 3. Within 3 ft. (1 m) of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. (8 m) along each run. Reduce intervals to 10 ft. (3 m) in areas of congested piping and equipment.
- E. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Fire-Suppression Pipe Label Color Schedule:
 - 1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valvetag schedule in the operating and maintenance manual. Include the identification "FSV" on all firesuppression system valve tags.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
 - 1. Valve-Tag Size and Shape:
 - a. 1-1/2 inches (38 mm), round.
 - 2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where shown.

END OF SECTION 210553

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and the following:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-suppression specialty valves.
 - 3. Concrete vaults.
 - 4. Alarm devices.
- A. Make arrangements with the utility companies for connection to water service. The entire utilities installations are included under this contract, including payment of all utility company charges, and including the points of tie-ins to utility company mains. Where meters, regulators, vaults, etc., are being furnished or furnished and installed by the utility companies, the Contractor shall pay any fees and charges connected with the particular installation such as tap-in charges, meter charges, installation charges, etc.
- B. Related Requirements:
 - 1. Section 211119 "Fire-Department Connections" for exposed-, flush-, and yard-type, fire-department connections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

- 1. Comply with requirements of utility company supplying the water. Include tapping of water mains and backflow prevention.
- 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A), water tube, annealed temper.
- B. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A), water tube, drawn temper.
- C. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
- B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
- C. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Flanges: ASME B16.1, Class 125, cast iron.

2.3 **JOINING MATERIALS**

- A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

2.4 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ford Meter Box Company, Inc. (The).
 - b. <u>Jay R. Smith Mfg Co; a division of Morris Group International.</u>
 - c. Viking Johnson.

- 2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
- 3. Standard: AWWA C219.
- 4. Center-Sleeve Material: Manufacturer's standard.
- 5. Gasket Material: Natural or synthetic rubber.
- 6. Pressure Rating: 150 psig (1035 kPa) minimum.
- 7. Metal Component Finish: Corrosion-resistant coating or material.

2.5 CORPORATION VALVES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. A.Y. McDonald Mfg. Co.
 - 2. Ford Meter Box Company, Inc. (The).
 - 3. Mueller Co.
- B. Corporation Valves: Comply with AWWA C800. Include saddle and valve compatible with tapping machine and manifold.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Meter Valves: Comply with AWWA C800 for high-pressure, service-line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

2.6 CURB VALVES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. A.Y. McDonald Mfg. Co.
 - 2. Ford Meter Box Company, Inc. (The).
 - 3. Mueller Co.
- B. Curb Valves: Comply with AWWA C800 for high-pressure, service-line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.
- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
 - 1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- D. Meter Valves: Comply with AWWA C800 for high-pressure, service-line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

2.7 DETECTOR CHECK VALVES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Badger Meter, Inc.</u>
 - 2. Kennedy Valve Company; a division of McWane, Inc.
 - 3. Mueller Co.
 - 4. <u>WATTS</u>.
 - 5. Zurn Industries, LLC.
- B. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
- C. Standards: UL 312 and FM Global's "Approval Guide."
- D. Pressure Rating: 175 psig (1200 kPa).
- E. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2.8 WATER METERS

A. Coordinate with water company to furnish and install meter(s) required or install meters provided.

2.9 DETECTOR-TYPE WATER METERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Badger Meter, Inc.</u>
 - 2. Mueller Co.
 - 3. Neptune Technology Group Inc.
- B. Fire-Protection, Detector Check Water Meters:
 - 1. Description: Main-line turbine meter with strainer and second meter on bypass.
 - 2. Standards: UL's "Fire Protection Equipment Directory" listing and FM Global's "Approval Guide."
 - 3. Registration: Flow in gallons (liters).
 - 4. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 5. Bypass Meter: AWWA C701, turbine-type, bronze case.
 - a. Size: At least NPS 2 (DN 50).

2.10 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. <u>Mueller Co</u>.
- b. WATTS.
- c. <u>Zurn Industries, LLC</u>.
- 2. Standard: ASSE 1013 or AWWA C511.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 12 psig (83 kPa) maximum, through middle one-third of flow range.
- 5. Body Material: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
- 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
- 7. Configuration: Designed for horizontal, straight through flow.
- 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Double-Check, Detector-Assembly Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ames Fire & Waterworks; A WATTS Brand.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. Mueller Co.
 - d. WATTS.
 - e. Zurn Industries, LLC.
 - 2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle one-third of flow range.
 - 5. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
 - 6. End Connections: Flanged.
 - 7. Configuration: Designed for horizontal, straight through flow.
 - 8. Accessories:
 - Valves: UL 262 and FM Global's "Approval Guide" listing; OS&Y gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.11 ALARM DEVICES

- A. General: UL 753 and FM Global's "Approval Guide" listing, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig (1725-kPa) working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company's standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
- E. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- G. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:
 - 1. Under Driveways: With at least 36 inches (910 mm) of cover over top.
 - 2. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) of additional cover.
- H. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

- I. Extend fire-suppression water-service piping and connect to water-supply source and building firesuppression water-service piping systems at locations and pipe sizes indicated.
 - 1. Terminate fire-suppression water-service piping within the building at the floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.
- J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- K. Comply with requirements for fire-suppression water-service piping inside the building in the following Sections:
 - 1. Section 211313 "Wet-Pipe Sprinkler Systems
- L. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping inside the building.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.3 **JOINT CONSTRUCTION**

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
- F. Copper-Tubing, Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- G. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- H. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- I. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- J. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- K. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers.

3.6 DETECTOR CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves and piping on concrete piers. Comply with requirements for concrete piers.

3.7 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Support water meters and piping NPS 3 (DN 80) and larger on concrete piers. Comply with requirements for concrete piers

3.8 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 (DN 65) and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire-department connection to mains.
- B. Install protective pipe bollards on two sides of each freestanding fire-department connection. Pipe bollards are specified.

3.10 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
 - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
 - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in electrical sections.

3.11 CONNECTIONS

A. Connect fire-suppression water-service piping to existing water main.

B. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.12 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig (zero kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare test and inspection reports.

3.13 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping.

3.14 CLEANING

- A. Clean and disinfect fire-suppression water-service piping as follows:
 - 1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.
 - b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - c. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

3.15 PIPING SCHEDULE

- A. Underground fire-suppression water-service piping NPS 2 (DN 50) and smaller shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.

- B. Underground fire-suppression water-service piping NPS 3 (DN 80) shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; mechanical-joint, [ductile- or gray-iron, standard-pattern] [or] [ductile-iron, compact-pattern] fittings; glands, gaskets, and bolts; and gasketed joints.
- C. Underground fire-suppression water-service piping NPS 4 (DN 100) shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
- D. Underground fire-suppression water-service piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
- E. Aboveground fire-suppression water-service piping NPS 2 (DN 50) and smaller shall be hard copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought- or cast-copper-alloy, solder-joint fittings; and brazed joints.
- F. Aboveground fire-suppression water-service piping NPS 3 and NPS 4 (DN 80 and DN 100) shall bethe following:
 - 1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
- G. Aboveground fire-suppression water-service piping NPS 5 to NPS 12 (DN 125 to DN 300) shall be grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
- H. Underslab fire-suppression water-service piping NPS 2 (DN 50) and smaller shall be soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
- I. Underslab fire-suppression water-service piping NPS 3 and NPS 4 (DN 80 and DN 100) shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
- J. Underslab fire-suppression water-service piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be[one of] the following:
 - 1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.

3.16 VALVE SCHEDULE

- A. Underground fire-suppression water-service shutoff valves NPS 2 (DN 50) and smaller shall be corporation valves or curb valves with ends compatible with piping.
- B. Underground fire-suppression water-service shutoff valves NPS 3 (DN 80) and larger shall be one of the following:
 - 1. 200-psig (1380-kPa), AWWA, iron, nonrising-stem, resilient-seated gate valves.
 - 2. 175-psig (1200-kPa), UL-listed or FM Global-approved, iron, nonrising-stem gate valves.
- C. Indicator-post underground fire-suppression water-service valves NPS 3 (DN 80) and larger shall be 175-psig (1200-kPa), UL-listed or FM Global-approved, iron, nonrising-stem gate valves with indicator-post flange.
- D. Standard-pressure, aboveground fire-suppression water-service shutoff valves NPS 3 (DN 80) and larger shall be one of the following:

- 1. 200-psig (1380-kPa), AWWA, iron, OS&Y, resilient-seated gate valves.
- 2. 175-psig (1200-kPa), UL-listed or FM Global-approved, iron, OS&Y gate valves.
- 3. AWWA or UL-listed or FM Global-approved butterfly valves.
- E. Fire-suppression water-service check valves NPS 3 (DN 80) and larger shall be one of the following:
 - 1. AWWA or UL-listed or FM Global-approved check valves.
 - 2. UL-listed or FM Global-approved detector check valves.

END OF SECTION 211100

SECTION 211119 - FIRE-DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - Yard-type fire-department connections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.1 YARD-TYPE FIRE-DEPARTMENT CONNECTION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Elkhart Brass Mfg. Company, Inc.
 - 2. Fire-End & Croker Corporation.
 - 3. Fire Protection Products, Inc.
 - 4. <u>GMR International Equipment Corporation</u>.
 - 5. Guardian Fire Equipment, Inc.
 - 6. <u>Potter Roemer</u>.
 - 7. Wilson & Cousins Inc.
- B. Standard: UL 405.
- C. Type: Exposed, freestanding.
- D. Pressure Rating: 175 psig (1200 kPa) minimum.
- E. Body Material: Corrosion-resistant metal.
- F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- G. Caps: Brass, lugged type, with gasket and chain.

- H. Escutcheon Plate: Round, brass, floor type.
- I. Outlet: Bottom, with pipe threads.
- J. Number of Inlets: Two.
- K. Escutcheon Plate Marking: Similar to "AUTO SPKR."
- L. Finish: Polished chrome plated.
- M. Outlet Size: NPS 4 (DN 100).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.
- B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install yard-type fire-department connections in concrete slab support. Comply with requirements for concreteother section.
- B. Install two protective pipe bollards on sides of each fire-department connection. Comply with requirements for bollards.
- C. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Pipes, fittings, and specialties.
- 2. Specialty valves.
- 3. Sprinklers.
- 4. Alarm devices.
- 5. Pressure gauges.

B. Related Requirements:

- Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire water service backflow prevention devices.
- 2. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
- 3. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 **DEFINITIONS**

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig (1200-kPa) maximum.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For wet-pipe sprinkler systems.
 - 1. Include plans, elevations, sections, and attachment details.

- 2. Include diagrams for power, signal, and control wiring.
- D. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and professional engineer or designer.
- B. Design Data:
 - 1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Welding certificates.
- D. Field Test Reports:
 - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - 2. Fire-hydrant flow test report.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional services needed to assume responsibility. Base calculations on results of firehydrant flow test.
 - a. Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.9 FIELD CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.
- C. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.
 - 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: 5/18/2020.
 - b. Performed by: Forrest Pollock of Hardin County Water District No. 2.
 - c. Static Pressure at Residual Fire Hydrant R: 55 psi.
 - d. Measured Flow at Flow Fire Hydrant F: 993 gpm.
 - e. Residual Pressure at Residual Fire Hydrant R: 45 psi.
 - 2. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Building Service Areas: Ordinary Hazard, Group 1.
 - 2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 3) Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
 - 4) General Storage Areas: Ordinary Hazard, Group 1.
 - 5) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - 6) Office and Public Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
 - c. Special Occupancy Hazard: As determined by authorities having jurisdiction.

- 4. Maximum protection area per sprinkler according to UL listing.
- E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7. See Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

2.2 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Black-Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
- D. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- E. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.
- F. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, ASME B16.21, nonmetallic and asbestos free, or EPDM rubber gasket.
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- J. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
 - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- K. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.

- c. <u>Victaulic Company</u>.
- 2. Pressure Rating: [175-psig (1200-kPa)] [250-psig (1725-kPa)] [300-psig (2070-kPa)] minimum.
- 3. Painted or Uncoated Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
- 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) and ASTM B88, Type L (ASTM B88M, Type B).
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- F. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- G. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>T-DRILL Industries Inc.</u>
 - 2. Description: Tee formed in copper tube according to ASTM F2014.
- H. Grooved, Mechanical-Joint, Copper-Tube Appurtenances:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Shurjoint; a part of Aalberts Integrated piping Systems.
 - c. <u>Victaulic Company</u>.
 - 2. Standard: UL 213.
 - 3. Grooved-End Copper Fittings: ASTM B75 (ASTM B75M) copper tube or ASTM B584 bronze castings.
 - 4. Grooved-End-Tube Couplings: To fit copper tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting EPDM-rubber gasket rated for minimum 180 deg F (80 deg C) for use with ferrous housing and steel bolts and nuts; 300 psig (2060 kPa) minimum CWP pressure rating.

2.4 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:

- 1. Standard-Pressure Piping Specialty Valves: 175-psig (1200-kPa) minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Globe Fire Sprinkler Corporation</u>.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. <u>Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North</u> America.
 - d. <u>Victaulic Company</u>.
 - e. <u>Viking Corporation</u>.
 - 2. Standard: UL 193.
 - 3. Design: For horizontal or vertical installation.
 - Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
 - 5. Drip cup assembly pipe drain without valves and separate from main drain piping
 - 6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Automatic (Ball Drip) Drain Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - 2. Standard: UL 1726.
 - 3. Pressure Rating: 175-psig (1200-kPa) minimum.
 - 4. Type: Automatic draining, ball check.
 - 5. Size: NPS 3/4 (DN 20).
 - 6. End Connections: Threaded.

2.5 AIR VENT

- A. Manual Air Vent/Valve:
 - 1. Description: Ball valve that requires human intervention to vent air.
 - 2. Body: Forged brass.
 - 3. Ends: Threaded.
 - 4. Minimize Size: 1/2 inch (13 mm).
 - 5. Minimum Water Working Pressure Rating: 300 psig (2070 kPa).
- B. Automatic Air Vent:
 - 1. Description: Automatic air vent that automatically vents trapped air without human intervention.
 - 2. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler systems.
 - 3. Vents oxygen continuously from system.

- 4. Float valve to prevent water discharge.
- 5. Minimum Water Working Pressure Rating: 175 psig (1207 kPa).

C. Automatic Air Vent Assembly:

- 1. Description: Automaticair vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly.
- 2. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler system.
- 3. Vents oxygen continuously from system.
- 4. Float valve to prevent water discharge.
- 5. Minimum Water Working Pressure Rating: 175 psig (1207 kPa).

2.6 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Anvil International/Smith-Cooper International; Tailwind Capital, LLC.</u>
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. <u>Victaulic Company</u>.
- 2. Standard: UL 213.
- 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
- 5. Type: Mechanical-tee and -cross fittings.
- 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
- 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
- 8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. Victaulic Company.
- 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
- 5. Size: Same as connected piping.
- 6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Potter Electric Signal Company, LLC.
 - c. Potter Roemer LLC; a Division of Morris Group International.

- 2. Standard: UL 199.
- 3. Pressure Rating: 175 psig (1200 kPa).
- 4. Body Material: Brass.
- 5. Size: Same as connected piping.
- 6. Inlet: Threaded.
- 7. Drain Outlet: Threaded and capped.
- 8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North</u> America.
 - b. <u>Victaulic Company</u>.
 - c. Viking Corporation.
- 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 4. Body Material: Cast- or ductile-iron housing with sight glass.
- 5. Size: Same as connected piping.
- 6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aegis Technologies, Inc.
 - b. CECA, LLC.
 - c. CPS Products, Inc.
- 2. Standard: UL 1474.
- 3. Pressure Rating: 250-psig (1725-kPa) minimum.
- 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
- 5. Size: Same as connected piping.
- 6. Length: Adjustable.
- 7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>FlexHead Industries, Inc.</u>
 - b. Gateway Tubing, Inc.
 - c. <u>Victaulic Company</u>.
- 2. Standard: UL 1474.
- 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
- 4. Pressure Rating: 175-psig (1200-kPa) minimum.
- 5. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Reliable Automatic Sprinkler Co., Inc. (The).
 - 3. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - 4. <u>Victaulic Company</u>.
 - 5. <u>Viking Corporation</u>.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig (1200-kPa) maximum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.
- E. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig (1725-kPa) minimum.
- F. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 2. Nonresidential Applications: UL 199.
 - 3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- G. Sprinkler Finishes: Chrome plated.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- I. Sprinkler Guards:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. <u>Victaulic Company</u>.
 - d. <u>Viking Corporation</u>.
 - 2. Standard: UL 199.
 - 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Globe Fire Sprinkler Corporation</u>.
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. Victaulic Company.
 - d. <u>Viking Corporation</u>.
- 2. Standard: UL 753.
- 3. Type: Mechanically operated, with Pelton wheel.
- 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
- 5. Size: 8-1/2-inches (216-mm) diameter.
- 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
- 7. Inlet: NPS 3/4 (DN 20).
- 8. Outlet: NPS 1 (DN 25) drain connection.
- C. Electrically Operated Notification Appliances:
 - 1. Electric Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: 6-inch (150-mm) minimum- diameter.
 - d. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

D. Water-Flow Indicators:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. McDonnell & Miller.
 - b. Potter Electric Signal Company, LLC.
 - c. Viking Corporation.
 - d. WATTS.
- 2. Standard: UL 346.
- 3. Water-Flow Detector: Electrically supervised.
- 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 5. Type: Paddle operated.
- 6. Pressure Rating: 250 psig (1725 kPa).
- 7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Potter Electric Signal Company, LLC.
 - b. <u>Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.</u>
 - c. <u>Viking Corporation</u>.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised water-flow switch with retard feature.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.

- 5. Design Operation: Rising pressure signals water flow.
- F. Valve Supervisory Switches:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Fire-Lite Alarms; Honeywell International, Inc.</u>
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. Potter Electric Signal Company, LLC.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.
 - 6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.9 PRESSURE GAUGES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AMETEK, Inc.
 - 2. Ashcroft Inc.
 - 3. <u>WIKA Instrument Corporation</u>.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gauge Range: 0- to 250-psig (0- to 1725-kPa) minimum.
- E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection. Include pressure gauges with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables and for piping insulation.

- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 **JOINT CONSTRUCTION**

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- L. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

- M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

- 1. Install valves in vertical position for proper direction of flow, in main supply to system.
- 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
- 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

E. Air Vent:

- 1. Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
- 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent
- 3. Pipe from outlet of air vent to drain.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wettype sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks
 exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:
 - 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 3. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - 4. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
 - 6. Type L (Type B), hard copper tube with plain ends; cast- or wrought-copper, solder-joint fittings; and brazed joints.

- 7. NPS 2 (DN 50), Type L (Type B), hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
 - 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 3. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - 4. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
 - 6. Type L (Type B), hard copper tube with plain ends;cast- or wrought-copper, solder-joint fittings; and brazed joints.
 - 7. Type L (Type B), hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
- F. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:
 - 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight or Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 3. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - 4. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
 - 6. Type L (Type B), hard copper tube with plain ends; cast- or wrought-copper, solder-joint fittings; and brazed joints.
 - 7. Type L (Type B), hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

3.12 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
 - 5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 211313

DIVISION 22-PLUMBING

SECTION 220000 -- GENERAL PROVISIONS FOR PLUMBING

PART 1 - GENERAL

1.1 GENERAL

- A. The General Conditions, Special Conditions, Supplemental Conditions, Instructions to Bidders, and other Contract Documents apply to this branch of the work as well as to the other branches.
- B. Provide the materials (piping, equipment, equipment accessories, etc.) and labor necessary for complete and functioning plumbing systems. The Drawings and Specifications are intended to indicate complete working systems. Provide complete and properly working systems, even if all materials and labor necessary to achieve this are not specifically shown on the Drawings or specified.
- C. The Contractor shall familiarize himself with the work of all other trades, general type construction, and the relationship of his work to other sections. He shall examine all working drawings, specifications and conditions affecting his work. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, verify all dimensions in the field and advise the Engineer of any discrepancy before fabricating or performing any work.
- D. The work shall include complete testing of all equipment and piping at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment.
- E. Perform any necessary temporary work during construction.
- F. Work under this section shall conform to governing codes, ordinances and regulations of the City, County and State.
- G. The Contractor shall be responsible for any errors in fabrication, for the correct fitting, installation and erection of the various mechanical systems.

1.2 REDUCTION OF LEAD IN DRINKING WATER ACT

A. In accordance with the "Reduction of Lead in Drinking Water Act" of 2011, all potable water pipe, pipe fittings, plumbing fittings and fixtures shall have a 0.25% maximum lead content for all wetted components using a surfaced bases averaging formula. This includes all components of potable water systems as well as combined fire and domestic water systems. Products that are specified in the document as basis of design, shall comply with this regulation or be substituted with an approved equal.

1.3 VIBRATION ISOLATION

A. Installation of vibration isolation equipment pertaining to plumbing systems shall be by this Contactor.

1.4 POWDER ACTUATED CONCRETE FASTENERS

- A. Obtain written approval from the structural engineer before using powder-actuated concrete fasteners.
- B. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

1.5 SUSPENSION FROM METAL DECKING

A. Do not use metal decking for suspension of piping or equipment. Hang items from top member of joist or provide additional structure to span between top members if needed.

1.6 COORDINATION BETWEEN TRADES

- A. Demand and examine all Drawings and Specifications pertaining to the construction before installing the work described and shown under these Drawings and Specifications. Cooperate with all other Contractors in locating piping, ductwork, conduit, openings, chases and equipment in order to avoid conflict with any other Contractor's work. Give special attention to points where piping must cross ducts or other piping and where ducts, piping and conduit must fur into the walls and columns. All work installed above a lay-in ceiling must be coordinated and installed so there is a minimum of 4 inches between the top of the ceiling grid and the bottom of the installation.
- B. Make known to other trades intended positioning of materials and intended order of work. Determine intended position of work of other trades and intended order of installation.

1.7 DISCREPANCIES

A. If any discrepancies occur between the accompanying Drawings and these Specifications and Drawings and Specifications covering other Contracts, report such discrepancies to the Architect/Engineer far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of piping and equipment not installed in accordance with the above instructions, and which interferes with work and equipment of other Contractors.

1.8 EXISTING PIPE AND SERVICES

- A. Existing piping and services are located as accurately as possible from available information, but it shall be the Contractor's responsibility to locate, determine exact elevations and make required connections to such lines and services in manner approved by the Architect/Engineer.
- B. Maintain in operating condition active utilities encountered in the utility installation. Repair to the satisfaction of the Architect/ Engineer and the Owner any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.

1.9 CONTINUOUS OPERATION AND CUTOVER

A. To facilitate the continuous operation of the existing utilities, no utility service shall be tapped into without prior notification of 48 hours to and approval received from the designated authority of the utility company.

1.10 ASBESTOS

A. If during the course of his work the Contractor observes the existence of asbestos, or asbestos-bearing materials, the Contractor shall immediately terminate further work on the project and notify the Owner of the condition. The Owner will, after consultation with the Engineer, determine a further course of action.

1.11 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Extend all grease fittings to an accessible location.

1.12 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.13 PLUMBING INSTALLATIONS

- A. Coordinate plumbing equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements. Field verify existing conditions and all required measurements before fabricating any piping or equipment.
- C. Arrange for chases, slots, and openings in other building components to allow for plumbing installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Coordinate the cutting and patching of building components to accommodate the installation of plumbing equipment and materials.
- G. Where mounting heights are not detailed or dimensioned, install plumbing services and overhead equipment to provide the maximum headroom possible.
- H. Install plumbing equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- I. Coordinate the installation of plumbing materials and equipment above ceilings with suspension system, light fixtures, and other installations.
- J. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

- K. Do not install plumbing work where it will interfere with work of other trades.
- L. Do not install plumbing work under HVAC terminal units above suspended ceilings, such as heat pump units, air handling units, variable volume units, coils, etc.
- M. Do not install plumbing work where it will interfere with access doors in ductwork.
- N. Do not install plumbing work where it will interfere with access to control panels on HVAC and/or electrical equipment.
- O. Do not install plumbing work where it will interfere with access space around mechanical and electrical equipment. Do not install piping where it will interfere with removal of HVAC coils, filters or fan shafts.
- P. Do not install piping so close to ceiling that ceiling tiles in accessible ceilings cannot be removed without damaging them.
- Q. Do not install plumbing work over the top of electrical equipment. Maintain minimum distances away from electrical equipment as required by the Electric Code.
- R. Photographs: When all inaccessible plumbing work is installed and before any wallboards or hard ceilings installation is to begin, the contractor is to photograph all plumbing work in all inaccessible ceilings and walls. Each photograph is to have a label as a part of the photograph that indicates the orientation (i.e., north wall, south wall and etc.) and the room location. One copy of the photographs with a written description of each filename including orientation and room location are to be presented to the owner in digital (jpg) format. The resolution of the picture is to be of a level that is required to clearly show the location of all mechanical and electrical work.

1.14 EXCAVATION, TRENCHING AND BACKFILLING

- A. Photographs: The contractor shall photograph all underground utilities before backfilling. Photographs shall be oriented and labeled so that the locations, all crossings and depths of the utilities can be determined from the photographs.
- B. General: Excavate in accordance with requirements of Division Section "EARTHWORK" and requirements of this Section. Lay the pipe in open trench except when the Architect/Engineer gives written permission for tunneling. Open the trench sufficiently ahead of pipe laying to reveal obstructions. Maintain easy access to fire hydrants by fire fighting apparatus. Provide trench crossing as necessary to accommodate public travel.
- C. Provide trench crossing as necessary to accommodate public travel.
- D. Separate Trenches: Unless otherwise shown or requested, provide separate trenches for sewers, water lines and gas lines, respectively, with a minimum of 3' of undisturbed earth between trenches. In locations such as close to building, where separate trenches for sewers and water lines are impracticable, lay the water pipe on a solid shelf at least 18" above the top of the sewer. Always place gas lines in a separate trench from electrical lines.
- E. Width of Trench: Excavate trenches of sufficient width for proper installation of work. When the depth of backfill over sewer pipe exceeds 10', keep the trench at the level of the top of the pipe as narrow as possible.
- F. Sheeting and Bracing: Sheet and brace trenches as necessary to protect workmen and adjacent structures. Comply with local regulations or, in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and prevent injurious caving. When ordered in writing by the

- Architect/ Engineer, leave sheeting in place and the Contract will be adjusted (See General Conditions): cut off such sheeting not to be removed at least 3' below finished grade.
- G. Water Removal: Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper jointing of pipes. Conduct the discharge from trench dewatering to drains or natural discharge channels.
- H. Disposition of Utilities: Observe rules and regulations governing the respective utilities in executing work under this heading. Protect active utilities from damage or remove in accordance with written instructions of the Architect/Engineer (See General Conditions). Plug, cap or remove inactive and abandoned utilities encountered in trenching operations. In absence of specific requirements, plug or cap such utility line at least 3' from utility line to be installed or as required by local regulations.
- I. Rock Excavation: Materials to be excavated shall include earth and any other material including rock encountered within the limits of trench excavation for the utilities to the depth and extent indicated on the drawings and herein specified. In case of any change ordered by the Owner or Architect/Engineer in the quantity of excavation, the contract price will be adjusted by unit price or as described under Excavation, Filling and Grading of Division Site Work of these specifications. The term "rock" as used is defined to be hard material in nature that cannot be dislodged from its bed and removed therefrom without blasting or drilling. Any other is "earth" insofar as removal of the material to be excavated is concerned.
 - Allowance for Additional Rock Excavation: In addition to the rock removal specified in the
 preceding paragraph, include in the Contract Price an additional ten (10) cubic yards of trench rock
 removal by mechanical means. If more or less additional rock removal is required due to changes
 in routing or in elevations of underground utilities authorized in writing, the Contract Price will be
 adjusted via unit prices.
- J. Blasting: See Division Section "EARTHWORK" to see if blasting is allowed. If blasting is allowed, obtain written approval of method from Architect/Engineer before proceeding with rock excavation.
- K. Trench Bottoms: Lay all pipe, unless otherwise noted or detailed, in undisturbed earth on at least 4" of #9 crushed stone, or other approved grillage. Bedding shall be in place and graded before pipe is installed.
- L. Special Supports: Whenever, in the option of the Architect/Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting sewers or other utilities and appurtenances specified in this section, provide special support as the Architect/Engineer may direct and the Contract Price will be adjusted. (See General Conditions).
- M. Tree Protection: Exercise care to protect the roots of trees to remain. Within the branch spread of such trees, perform trenching by hand. Open the trench only when the utility can be installed immediately, prune injured roots cleanly and backfill as soon as possible. Perform this work under the direction of the Architect/Engineer.
- N. Backfilling: Inspect and test piping and record locations of pipe lines and appurtenances before backfilling.
- O. Trenches Under Floor Slabs: Backfill under floor slab on grade to a point 5'-0" outside of perimeter building wall with fill as specified in Division Section "EARTHWORK". Remove excess excavation materials from the site daily unless otherwise instructed.
- P. Trenches in Other Areas: Backfill with materials in accordance with Division Section "EARTHWORK". Compact backfill thoroughly with a heavy tamper.
- Q. The Contractor, at his option, may backfill the remaining depth of the trench from 12" above top of piping to 12" below finished grade with sand, wash gravel, or fine rock chat. The remaining depth of the trench would then be backfilled as specified in the preceding specification.

1.15 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.

1.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

1.17 WORKING DRAWINGS

- A. Scale of drawings is approximate. Do not scale the drawings to determine locations of plumbing work. Exact locations, dimensions and elevations shall be governed by field conditions. Make field measurements of building before fabricating or installing equipment or materials.
- B. Drawings are based on physical dimensions of one or more manufacturer's equipment. Other approved equipment shall be of such dimensions that it can be readily installed in available space, leaving ample clearance for proper maintenance.
- C. Intent of drawings is to show systems and sizes. Drawings do not necessarily show all required offsets. Work shall be installed to conform with space limitations. Offsets, transitions, fittings, etc., shall be provided as part of the Contract where required to attain this objective.

1.18 EQUIPMENT MOUNTING

- A. Mount equipment with moving parts, such as compressors, pumps, etc., on vibration supports suitable for the purpose of minimizing noise and vibration transmission unless otherwise specified. In addition, isolate equipment from external connections such as piping, with flexible connectors, vibration isolators, or other approved means.
- B. Provide each piece of equipment or apparatus suspended from the ceiling or mounted above the floor level with suitable structural support, pipe stand, platform or carrier as approved by the Architect/Engineer.

1.19 PAINTING

- A. Paint the following items.
 - 1. Exposed plumbing piping, valve bodies and fittings bare and insulated, including hangers, platforms, etc.
 - 2. "Exposed" shall mean exposed to view, such as, in mechanical spaces, tunnels, on roofs and in rooms with no suspended ceilings.

- B. Colors of piping shall be as specified in the "Identification for Plumbing Piping and Equipment" section of the Specifications. See "color coding" in identification schedules.
- C. Painting shall be done in accordance with the "Painting" section of the specifications unless otherwise specified under other sections of the specifications,
- D. Do not paint aluminum and stainless steel equipment, motor and identification plates, tags, etc.
- E. Do not paint piping concealed in walls or above suspended ceilings.

1.20 DEBRIS

A. Remove from the site any debris and dirt caused by the work. Maintain the premises in a clean and orderly condition.

1.21 PROTECTION OF EQUIPMENT AND MATERIALS

A. Provide suitable protection from dampness damage, dirt, etc., for equipment and materials during construction and until final acceptance by the Owner. Keep ends of piping capped off when work on them is not in progress. Such protection shall be by a means acceptable to the Architect/Engineer.

1.22 CLEANING UP

A. After completion of the work and before final acceptance of the work, thoroughly clean equipment and materials and remove foreign matter such as grease, dirt, labels, stickers, etc., from the exterior of piping, equipment and associated fabrications.

1.23 EQUIPMENT CONNECTIONS

- A. Make connections to equipment furnished by others whenever such equipment is shown on any part of the drawings or mentioned in any section of the specifications.
- B. Verify equipment locations and the sizes, number, locations, and types of connections to be made before installation of any such equipment.

1.24 EQUIPMENT INSTALLATION INSTRUCTIONS

A. Install plumbing piping and equipment in strict accordance with manufacturer's recommendations. Provide equipment accessories necessary for proper operation or recommended by the manufacturer, even if such accessories are not shown on the drawings or mentioned in the specifications.

1.25 PERMITS, CODES AND APPROVALS

- A. Permits. Obtain and pay for the permits and licenses necessary for the complete plumbing systems from the authorities governing such work.
- B. Codes. Installation shall be in accordance with applicable codes and regulations, including but not limited to the following:

- 1. City or County Building Inspector
- 2. National and Local Electric Codes
- 3. Kentucky State Plumbing Code
- 4. Kentucky Building Code and its referenced codes
- 5. Kentucky State Fire Marshal
- 6. Local Fire Codes
- 7. Local Building Inspections
- C. Approvals. All work must be approved by the Architect/Engineer before final payment is made.
- D. Obtain a final certificate of approval for the entire plumbing installation from the Department of Housing, Building and Construction, Division of Plumbing. Submit to the Architect/Engineer after completion of the work and before final payment is made.

1.26 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. When making a shop drawing submittal for materials and/or equipment of a different manufacturer than that specified, it shall be understood and agreed that such substitution if approved will be made without cost to the Owner, regardless of changes in connections, spacing, electrical service, etc.

1.27 WORKMANSHIP

A. Work shall be performed by mechanics skilled in their respective trades and shall present appearance typical of best trade practice. Work not installed in this manner shall be repaired, removed or replaced, or otherwise remedied as directed by the Architect/Engineer.

1.28 RECORD DRAWINGS

A. Keep accurate record of deviations from drawings, particularly where work is concealed. Submit one (1) set of drawings marked to show changes when work is completed.

1.29 SUPERVISION

- A. The Contractor shall personally supervise the work or have a competent superintendent, satisfactory to the Architect/Engineer and Owner on the work at all times during progress with full authority to act.
- B. The Contractor shall lay out his work and be responsible for any necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so. Work at the site of the project shall be observed by the Architect/Engineer or his representative.
- C. Final Inspection: At the time of final inspection of the work performed under this Contract, systems shall be complete in every respect and in perfect operating condition. Surplus materials of every character resulting from work of this section shall have been removed. Sanitary sewers shall be free from sand, silt or other obstructions. Any defect discovered in the utilities subsequent to this inspection shall have been corrected.

1.30 STRUCTURAL RESPONSIBILITY

- A. The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing, or weakening. No structural member shall be cut or otherwise weakened in any manner without the written consent of the Architect/Engineer.
- B. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Owner or Architect/Engineer, without cost to either the Owner or the Architect/ Engineer.

1.31 OPENINGS

- A. This Contractor shall be responsible for the openings he may require in floors, walls, roof or ceilings of any type of new or existing construction whether or not shown on the Architectural, Structural or Plumbing Drawings.
- B. Openings that have been shown on the Architectural and/or Structural Drawings will be provided under other Divisions; however, the responsibility for the correct size and location of such openings shall be that of this Contractor.
- C. Openings that have not been shown on the Architectural and/or Structural Drawings shall be provided by this Contractor.
- D. Review and conform to all structural requirements as detailed or specified in the Structural drawings and specifications.

1.32 CUTTING, FITTING AND PATCHING

- A. Before doing any cutting or drilling, Contractor shall obtain permission from the Architect/Engineer and shall follow his instructions as to how proposed cutting or drilling is to be done.
- B. Do any cutting, patching, drilling of masonry, steel, wood or iron work and any fitting necessary for the proper installation of apparatus and materials included in these specifications or governed thereby.
- C. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- D. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- E. Coordinate with the Structural Engineer BEFORE drilling, cutting, notching, etc., any new or existing structural members. Obtain written permission from Structural Engineer before doing such work. Locations and sizes of openings and methods of cutting or drilling such openings must be approved in advance by the Structural Engineer. Positively identify exact locations of reinforcing bars or tension cables in structural members by X-raying or other methods approved by the Structural Engineer if required by the Structural Engineer.
- F. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

- G. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
- H. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
- I. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
- J. Comply with requirements of applicable Sections of Division 22 "Plumbing" where cutting and patching requires excavating and backfilling.
- K. The patching and finishing shall be done in a workmanlike manner to the satisfaction of the Architect/Engineer.
- L. Patch any openings in existing floors, walls, ceilings or roof, left by removal of existing plumbing work.
- M. Review and conform to all structural requirements as detailed or specified in the Structural drawings and specifications.

1.33 CONNECTIONS TO EXISTING UTILITY MAINS

- A. Make arrangements with the utility companies for connection to such services as water, sewer, gas, etc. The entire utilities installations are included under this contract, including payment of all utility company charges, and including the points of tie-ins to utility company mains. Where meters, regulators, vaults, etc., are being furnished or furnished and installed by the utility companies, the Contractor shall pay any fees and charges connected with the particular installation such as tap-in charges, meter charges, installation charges, etc.
- B. Install meters, regulators, etc. furnished by the utilities companies.
- C. Pipe up meters in accordance with utility company's requirements. Provide meters, regulators, shutoff valves, bypass valves, test plugs, piping, fittings and any other devices required by the utility company. In addition, provide any devices required by the Drawings.

1.34 TEMPORARY UTILITIES

A. In any installation that requires deletion of existing services to install new services, a means of providing temporary service for the intermediate period shall be provided. The means of providing temporary service is to be reviewed and revised as required by the Engineer. This means of providing temporary service is to include but not limited to piping and its associated fittings, valves, insulation, restraints & thrust blocks and all other components required to make a temporary service operational to a level equal to the existing utility service.

1.35 RESTORATION OF SURFACES

A. Each Contractor shall restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, shrubs, and other items damaged or removed by his operations that are outside of the Limit of Site boundaries. Replacement and repairs shall be in accordance with good construction practice and shall match material employed in the original construction of the item to be replaced.

1.36 SHOP DRAWINGS AND OTHER REQUIRED SUBMITTALS

A. Comply with requirements listed in Division 1 Section – SUBMITTAL PROCEDURES and the following paragraphs.

B. Definitions

- 1. Action Submittals: See Division 1 Section "SUBMITTAL PROCEDURES".
- 2. Informational Submittals: See Division 1 Section "SUBMITTAL PROCEDURES".
- C. Submittals may be submitted in electronic format. Submit in accordance with requirements in Division 1 Section "SUBMITTAL PROCEDURES" and requirements of this Section.
- D. Prepare and submit to the Architect/Engineer for review, shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc., and any other data required.
- E. Submittal data shall have the stamp of approval of the General Contractor to show that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval will be returned for proper resubmission.
- F. No roughing-in, connections, etc., shall be done until acceptable shop drawings are in the hands of the Contractors. It shall be the responsibility of the Contractor to obtain acceptable shop drawings and to make connections, etc., in the neatest and most workmanlike manner possible.
- G. Submittal data must be complete for each piece of equipment. Partial or incomplete data will not be processed.
- H. Architect/Engineer's review of shop drawings the applies only to general design, arrangement, type, capacity and quality. Such approval does not apply to quantities, dimensions, connection locations, etc. In these cases, the Contractor alone shall be responsible for furnishing the proper quantity of the equipment and/or materials required for seeing that the equipment fits the available space in a satisfactory manner and that piping, electrical and other connections are suitably located.
- I. The Architect's/Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for deviations from drawings or specifications unless he has, in writing, called the Architect's/Engineer's attention to such deviation at the time of submission and secured his written acceptance nor shall it relieve him from responsibility for error in shop drawings or schedules.
- J. Submittal data must be complete and acceptable before project is accepted.

1.37 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. This Contractor shall prepare three loose-leaf, bound brochures, entitled "Plumbing Equipment Operation and Maintenance Data." Mark identification on both front and spine of each binder. Each binder shall be a heavy duty 3-ring, vinyl-covered binder with pocket folders for folded sheet information. Each binder cover and spline shall have the project name (as listed on the drawings), and what is in the binder. If more than one binder is provide the cover and spline shall be marked with "Volume? of?". Binders shall be properly indexed (thumb- tabbed). Information shall be filed under applicable specification section number.
- B. Each brochure shall contain the following information:
 - 1. Name and address of Consulting Engineer, Contractor, and index of equipment, including vendor (name and address).

- 2. Complete brochures, descriptive data and parts list, etc., on each piece of equipment, including all approved shop drawings.
- 3. Complete maintenance and operating instructions, prepared by the manufacturer, on each major piece of equipment.
- C. All brochures shall be submitted to the Architect/Engineer or his representative prior to final inspection of the building.
- D. In addition to hard copy, provide electronic pdf copy of manuals. Electronic pdf copy shall be bookmarked identical to above instructions for hard copy.

1.38 OWNER INSTRUCTION

- A. Conduct a minimum of a full-day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of mechanical equipment and systems.
- B. Engage factory-authorized service representatives for the following equipment to train Owner's maintenance personnel:
 - 1. Domestic water heaters
 - 2. Water softener
- C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Review data in the operation and maintenance manuals.
- D. Explain the identification system, operational diagrams, emergency and alarm provisions, safety, efficiency and similar features of the systems.
- E. Video the instruction sessions and turn over video to the Owner. The video shall be provided to the owner in electronic format acceptable to the owner.

1.39 PERMANENT PLUMBING SYSTEM OPERATION DURING CONSTRUCTION (NEW AND EXISTING TO REMAIN)

- A. Provide permanent plumbing system operation to all areas of campus during construction.
- B. Existing plumbing systems must remain in operation until occupied spaces served by each system have been vacated.

1.40 SYSTEM DESIGN WORKING PRESSURES

A. Provide all piping system components suitable for 125 psig minimum steam working pressure.

1.41 MAINTAINING EXISTING SERVICES

A. Properly make all temporary connections that may be necessary to continue these services in a safe and substantial manner until the permanent services are activated. Upon completion, remove all temporary work, and completely restore all areas that may be affected.

1.42 OWNER OCCUPANCY

A. Full Owner Occupancy: The Owner will occupy buildings surrounding construction area during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work to minimize interference with the Owner's operations. Perform portions of work on premium time if required to do so by the Owner.

1.43 **DEMOLITION**

- Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
- B. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
- C. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
- D. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- E. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- F. Equipment to Be Removed and Salvaged: Disconnect and cap services and comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
 - 6. Salvage the following items:
 - a. None
- G. All other existing plumbing work (such as piping, valves, etc.) shall become the property of the Contractor and shall be removed from the job site.
- H. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- I. Remove or relocate existing plumbing work that interferes with new work of any kind.
- J. The Drawings show existing work to the extent possible. However, all existing work may not be shown. Remove or relocate any existing work that interferes with new work even if it is not shown on the Drawings.
- K. Remove existing work that does not have to remain in service. Relocate existing work that has to remain in service, as required to avoid interference with new work.
- L. Remove or relocate existing electrical work that interferes with new plumbing work, if such work is not indicated to be removed or relocated on the Electrical Drawings. Remove work that does not have to remain in service. Relocate work that has to remain in service, as required to avoid interference with new work.
- M. Existing work serving the floors above or below shall remain in service.

1.44 PROVIDING AIRTIGHT SPACES

- A. In rooms where room walls extend above ceiling to the floor or roof above, caulk around all new and existing penetrations through walls, ceilings, floors and/or roofs to make completely airtight rooms. Seal penetrations both above and below suspended ceilings. Seal any openings left by removal of any existing or new work. Caulking used shall be the same type as specified in the Architectural Specifications.
- B. Patch around rough openings of penetrations to form a tight fit before caulking.

1.45 PROFESSIONAL ENGINEER QUALIFICATIONS

A. When the term "professional engineer", or "qualified professional engineer" is used anywhere in these specifications it shall mean a person who is licensed to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 FIRESTOPPING

- A. Provide seals for any opening through any walls, floors, or ceilings used as passage for plumbing components.
- B. General: Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings as established by testing identical assemblies per ASTM E 814 by Underwriters' Laboratories, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction. Sealant shall provide protection equal or exceeding the fire resistance rating of fire rated walls, partitions, ceilings or floors. Use two-part or one part sealants as required to meet required fire resistance ratings.
- C. Foamed-In-Place Fire-Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around cables, conduit, pipes and similar penetrations through walls and floors.
- D. One-Part Fire-Stopping Sealant: One part elastomeric sealant formulated for use in a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors.
- E. Intumescent Fire-Stopping Sealant: A one-part, acrylic sealant that expands when exposed to heat.
- F. Firestop Compound: Trowelable compound for large openings
- G. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - 1. Foamed-in-Place Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
 - b. "Pensil 851"; General Electric Co.
 - 2. One-Part Fire-Stopping Sealant:

- a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
- b. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
- c. "RTV 7403"; General Electric Co.
- d. "Fyre Putty"; Standard Oil Engineered Materials Co.
- e. "FS 601": Hilti Inc.
- f. "FS 611A"; Intumescent Sealant; Hilti Inc.
- g. "FS 635"; Hilti Inc.
- H. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials to fill openings around plumbing services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.
- I. Fire Barrier Penetration Seals for Plastic Pipe Penetrations Through Fire Rated Assemblies: One part, organic/inorganic, fire resistive elastomeric sheet with aluminum foil on one side. Seal must be able of passing ASTM E-814 (UL 1479) Standard Method of Fire Tests for Through Penetration Fire Stops up to required fire resistance. Seal must be UL Classified. When heat is applied sufficient to melt the plastic pipe, the seal shall swell enough to seal off the opening left by the pipe, preserving the fire rated assembly. Install in accordance with manufacturer's recommendations. Material shall be equal to 3M No. FS-195 wrap/strip. An intumescent sealant may be used for small diameter plastic pipe.

2.2 ACCESS UNITS

- A. General. The work of this article is limited to the provisions for access through other work for access to plumbing work, and does not include internal access provisions (within the plumbing work). In general and where possible, furnish or furnish-and-mount required access units in other trades' work prior to their work, so that cutting and patching for the subsequent installation of such access units will not be required. In occupied spaces, provide finished access units of the maximum concealment type, including locks where appropriate, and matching access units provided in the same expanse of finish (for non-plumbing access, if any).
- B. The scope of access units to be furnished or provided as plumbing work includes those units indicated on the plumbing drawings or specified in Division 22 sections, and those additional units required for adequate access to Plumbing work and not shown or specified individually.
- C. Access Doors. Standard welded-steel construction, 16-gage frames and 14 gage door panels, 175 degree concealed spring hinges, rust-inhibitive prime coat, flush cam lock (for screw-driver operation where keyed lock is not required), recessed to receive applied finish where applicable (such as in concealed spline ceilings).
- D. Removable Access Plates. Where only hand access is sufficient, provide removable plate-type access unit, or minimum size which will facilitate the required access. Provide units of the type, style, design, material and finish appropriate for the location and exposure in each instance. In exposed surfaces of occupied spaces provide round plate units, flush floor units and frameless low-profile wall units, primed-for-paint in painted surfaces and polished chrome or stainless steel finish in other surfaces.
- E. Access Thru Fire Rated Walls or Ceilings. Where access doors or plates are required in fire rated partitions or ceilings, provide U.L. listed "B" Label doors or plates rated for 1-1/2 hours. Furnish doors with automatic closers and key operated latches that latch automatically when door closes.

2.3 FLASHING:

- A. General: Provide flashings from the following listing for each penetration of plumbing systems through roofs or waterproof membranes. Select appropriate flashing method for the type of roof used. Flashing shall be in accordance with roofing manufacturer's recommendations.
- B. Copper Flashing: Provide cold-rolled sheet copper, complying with ANSI/ASTM B 370, weighing 16 oz. per sq. ft. (0.0216" thick), except as otherwise indicated.
- C. Lead Flashing: Provide sheet lead complying with FS QQ-L-2201, Grade B; formed from common desilverized pig lead, complying with ANSI/ASTM B 29; weighing 4.0 lbs. per sq. ft., except as otherwise indicated.
- D. Bituminous Coating: FS TT-C-494, or MIL-C-18480, or SSPC-paint 12, cold-applied solvent-type bituminous mastic coating for application in dry film thickness of 15 mils per coat.
- E. Laminated Sheet Flashing: Bottom laminate of heavy-duty nonplasticized chlorinated polyethylene (CPE) synthetic elastomer, with top laminate of built-up roofing (BUR) sheet material; weighing 8 oz. per sq. ft.
- F. Manufacturer's Recommendations: Except as otherwise shown or specified, comply with recommendations and instructions of manufacturer of sheet metal being installed.
- G. Coat back side of lead flashings where in contact with concrete and other cementitious substrates, by painting surface in area of contact with heavy application of bituminous coating, or by other permanent separation as recommended by manufacturer of metal.
- H. On vertical surfaces, lap flashings minimum of 3".
- I. On vertical surfaces, for slopes of not less than 6" in 12", lap unsealed flashings minimum of 6".
- J. For embedment of metal flashing flanges in roofing or composition flashing or stripping, extend flanges minimum of 6" for embedment.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Sections.

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.3 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.4 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220000

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.

- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, LLC.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2. Zurn Industries, LLC.
- B. Description: Manufactured, Dura-coated or Duco-coated or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, LLC.
 - 2. CALPICO, Inc.
 - 3. <u>Metraflex Company (The)</u>.

B. Description:

- 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
- 2. Designed to form a hydrostatic seal of 20 psig (137 kPa) minimum.
- 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- 4. Pressure Plates: Stainless steel.
- 5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>GE Construction Sealants; Momentive Performance Materials Inc.</u>
 - b. Sherwin-Williams Company (The).
 - c. The Dow Chemical Company.
 - 2. <u>Verify sealant has a VOC</u> content of 250 g/L or less.
 - 3. <u>Verify sealant complies with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - 2. <u>Verify sealant has a VOC</u> content of 250 g/L or less.
 - 3. <u>Verify sealant complies with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Smooth-On.
 - 2. Verify sealant has a VOC content of 250 g/L or less.
 - 3. <u>Verify sealant complies with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas [2 inches (50 mm)] < Insert dimension > above finished floor level.
 - 2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeveseal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Stack-sleeve fittings.
 - b. Piping NPS 6 (DN 150) and Larger: Stack-sleeve fittings.
 - 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 **DEFINITIONS**

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>BrassCraft Manufacturing Co.; a Masco company</u>.
 - 2. <u>Dearborn Brass</u>.
 - 3. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Piping: One-piece, floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Filled-system thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
- B. Related Requirements:
 - 1. Section 221113 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FILLED-SYSTEM THERMOMETERS

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Ashcroft Inc</u>.

- b. <u>Marsh Bellofram</u>.
- c. Trerice, H. O. Co.
- d. Weiss Instruments, Inc.
- 2. Standard: ASME B40.200.
- 3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
- 4. Element: Bourdon tube or other type of pressure element.
- 5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
- 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
- 7. Pointer: Dark-colored metal.
- 8. Window: Glass.
- 9. Ring: Stainless steel.
- 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
- 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
- 12. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES or CSA.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 3/4 or NPS 1 (DN 20 or NPS 25), ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 3/4 and 1 inch (19 and 25 mm), with ASME B1.1 screw threads.
 - 8. Bore: Diameter required to match thermometer bulb or stem.
 - 9. Insertion Length: Length required to match thermometer bulb or stem.
 - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Ashcroft Inc</u>.
 - b. Marsh Bellofram.
 - c. Trerice, H. O. Co.
 - d. <u>WATTS</u>.
 - e. Weiss Instruments, Inc.
 - 2. Standard: ASME B40.100.
 - 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.

- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Ring: Stainless steel.
- 11. Accuracy: Grade A, plus or minus 1 percent of middle half of [Grade D, plus or minus 5 percent of whole] scale range.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
 - 2. Trerice, H. O. Co.
 - 3. WATTS.
 - 4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
 - 2. Trerice, H. O. Co.
 - 3. WATTS.
 - 4. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- J. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).
- B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C).

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 160 psi (0 to 1100 kPa).
- B. Scale Range for Domestic Water Piping: 0 to 160 psi (0 to 1100 kPa).

END OF SECTION 220519

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Steel ball valves.
 - 4. Iron ball valves.

1.2 **DEFINITIONS**

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.1 for flanges on iron valves.
- 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 4. ASME B16.18 for cast copper solder-joint connections.
- 5. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
- 6. ASME B16.34 for flanged and threaded end connections
- 7. ASME B31.9 for building services piping valves.
- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Type:
 - 1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
 - 2. Hand Lever: For quarter-turn valves smaller than NPS 4 (DN 100).
- G. Valves in Insulated Piping:
 - 1. Provide 2-inch (50-mm) extended neck stems.
 - 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.3 BRASS BALL VALVES

- A. Brass Ball Valves, Two Piece with Full Port and Brass Trim, Threaded or Soldered Ends:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. <u>Jenkins Valves; a Crane Co. brand.</u>
 - c. <u>WATTS</u>.
 - 2. Standard: MSS SP-110; MSS SP-145.
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body Design: Two piece.
 - 5. Body Material: Forged brass.

- 6. Ends: Threaded or soldered.
- 7. Seats: PTFE.
- 8. Stem: Brass.
- 9. Ball: Chrome-plated brass.
- 10. Port: Full.
- B. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. <u>Jenkins Valves; a Crane Co. brand.</u>
 - c. WATTS.
 - 2. Standard: MSS SP-110; MSS SP-145.
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body Design: Two piece.
 - 5. Body Material: Forged brass.
 - 6. Ends: Threaded or soldered.
 - 7. Seats: PTFE.
 - 8. Stem: Stainless steel.
 - 9. Ball: Stainless steel, vented.
 - 10. Port: Full.

2.4 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Jenkins Valves; a Crane Co. brand</u>.
 - b. NIBCO INC.
 - c. Zurn Industries, LLC.
 - 2. Standard: MSS SP-110; MSS SP-145.
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body Design: Two piece.
 - 5. Body Material: Bronze.
 - 6. Ends: Threaded or soldered.
 - 7. Seats: PTFE.
 - 8. Stem: Bronze or brass.
 - 9. Ball: Chrome-plated brass.
 - 10. Port: Full.
- B. Bronze Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Jenkins Valves; a Crane Co. brand.</u>
 - b. NIBCO INC.
 - c. WATTS.
 - 2. Standard: MSS SP-110; MSS SP-145.
 - 3. CWP Rating: 600 psig (4140 kPa).

- 4. Body Design: Two piece.
- 5. Body Material: Bronze.
- 6. Ends: Threaded or soldered.
- 7. Seats: PTFE.
- 8. Stem: Stainless steel.
- 9. Ball: Stainless steel, vented.
- 10. Port: Full.

2.5 STEEL BALL VALVES

- A. Steel Ball Valves with Full Port, Class 150, Flanged or Threaded Ends:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. NIBCO INC.
 - b. Stockham; a Crane Co. brand.
 - c. WATTS.
 - 2. Standard: MSS SP-72; MSS SP-110.
 - 3. CWP Rating: 285 psig (1964 kPa).
 - 4. Body Design: Split body.
 - 5. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
 - 6. Ends: Flanged or threaded.
 - 7. Seats: PTFE.
 - 8. Stem: Stainless steel.
 - 9. Ball: Stainless steel, vented.
 - 10. Port: Full.

2.6 IRON BALL VALVES

- A. Iron Ball Valves, Class 125, Flanged or Threaded Ends:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Valve, Inc.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. <u>WATTS</u>.
 - 2. Standard: MSS SP-72; MSS SP-110; MSS SP-145.
 - 3. CWP Rating: 200 psig (1380 kPa).
 - 4. Body Design: Split body.
 - 5. Body Material: ASTM A126, gray iron.
 - 6. Ends: Flanged or threaded.
 - 7. Seats: PTFE.
 - 8. Stem: Stainless steel.
 - 9. Ball: Stainless steel.
 - 10. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:

- 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valveend option or press-end option is indicated in valve schedules below.
- 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
- 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
- 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
- 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
- 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Brass ball valves, two piece with full port, and brass or stainless steel trim. Provide with threaded or solder-joint ends.
 - 2. Bronze ball valves, two piece with full port, and bronze, brass or stainless steel trim. Provide with threaded or solder-joint ends.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - 2. Steel ball valves, Class 150 with full port.
 - 3. Iron ball valves, Class 125.

END OF SECTION 220523.12

SECTION 220523.13 - BUTTERFLY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Iron, single-flange (lug-type) butterfly valves.
 - 2. Iron, flangeless (wafer-type) butterfly valves.
 - 3. Ductile-iron, grooved-end butterfly valves.
 - 4. Chainwheels.

1.2 **DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: ABS, Buna-N, or nitrile butadiene rubber.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:

Domestic water piping specialties intended to convey or dispense water for human consumption
must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and
NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSIaccredited third-party certification body) that the weighted average lead content at wetted surfaces
is less than or equal to 0.25 percent.

B. ASME Compliance:

- 1. ASME B16.1 for flanges on iron valves.
- 2. ASME B16.5 for flanges on steel valves.
- 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 4. ASME B31.9 for building services valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Types:
 - 1. Gear Actuator: For valves NPS 8 (DN 200) and larger.
 - 2. Hand lever: For valves NPS 6 (DN 150) and smaller.
 - 3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Installation of Valves" Article.
- G. Valves in Insulated Piping: Provide 2-inch (50-mm) extended neck stems.

2.3 IRON, SINGLE-FLANGE (LUG-TYPE) BUTTERFLY VALVES

- A. Iron, Single-Flange (Lug-Type) Butterfly Valves with Aluminum-Bronze Disc:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. NIBCO INC.
 - b. <u>WATTS</u>.
 - c. Zurn Industries, LLC.
 - 2. Standard: MSS SP-67, Type I.
 - 3. CWP Rating: 200 psig (1380 kPa).
 - 4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - 5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
 - 6. Seat: EPDM.
 - 7. Stem: One- or two-piece stainless steel.
 - 8. Disc: Aluminum bronze.

2.4 IRON, FLANGELESS (WAFER-TYPE) BUTTERFLY VALVES

- A. Iron, Flangeless (Wafer-Type) Butterfly Valves with Aluminum-Bronze Disc:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>DeZURIK</u>.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: MSS SP-67, Type I.
 - 3. CWP Rating: 150 psig (1035 kPa).
 - 4. Body Design: Flangeless (wafer type), suitable for bidirectional dead-end service at rated pressure.
 - 5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
 - 6. Seat: EPDM.
 - 7. Stem: One- or two-piece stainless steel.
 - 8. Disc: Aluminum bronze.

2.5 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

- A. Ductile Iron, Grooved-End Butterfly Valves, 175 CWP:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. NIBCO INC.
 - b. <u>Victaulic Company</u>.
 - c. <u>Zurn Industries, LLC</u>.
 - 2. Standard: MSS SP-67, Type I.
 - 3. CWP Rating: 175 psig (1200 kPa).
 - 4. Body Material: Coated, ductile iron.
 - 5. Stem: Two-piece stainless steel.
 - 6. Disc: Coated, ductile iron.
 - 7. Seal: EPDM.

2.6 CHAINWHEELS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Babbitt Steam Specialty Co.</u>
 - 2. Roto Hammer Industries; Rotork.
 - 3. <u>Trumbull Industries</u>.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
 - 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc or epoxy coating.
 - 2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Install chainwheels on actuators for butterfly valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
- G. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. If leakage cannot be repaired, replace valves.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron, Single-Flange (Lug-Type) Butterfly Valves: 200 CWP, EPDM seat, and aluminum-bronze disc.
 - 2. Iron, Flangeless (Wafer-Type) Butterfly Valves: 200 CWP, EPDM seat, and aluminum-bronze disc.
 - 3. Ductile-Iron, Grooved-End Butterfly Valves: 175 CWP.

END OF SECTION 220523.13

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze swing check valves.
 - 2. Iron swing check valves.
 - 3. Iron, grooved-end swing check valves.
 - 4. Iron, center-guided check valves.
 - 5. Iron, plate-type check valves.

1.3 **DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61[and NSF 372].

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B16.18 for solder joint.
 - 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Drinking Water System Components Health Effects and Drinking Water System Components Lead Content Compliance: NSF 61 and NSF 372.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 150:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Apollo Valves; a part of Aalberts Integrated Piping Systems.</u>
 - b. Jenkins Valves; a Crane Co. brand.
 - c. Jomar Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corp.
 - g. Stockham; a Crane Co. brand.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: Bronze.
- B. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - Crane Valves; a Crane Co. brand.
 - b. <u>Milwaukee Valve Company</u>.
 - c. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: PTFE.

2.3 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves with Metal Seats, Class 125:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. <u>Hammond Valve</u>.
 - d. Jenkins Valves; a Crane Co. brand.
 - e. KITZ Corporation.
 - f. Milwaukee Valve Company.
 - . Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged or threaded. See valve schedule articles.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
- B. Iron Swing Check Valves with Nonmetallic-to-Metal Seats, Class 125:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. APCO DeZurik Valve Co.
 - b. Crane Valves; a Crane Co. brand.
 - c. <u>Victaulic Company</u>.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged or threaded. See valve schedule articles.

- f. Trim: Composition.
- g. Seat Ring: Bronze.
- h. Disc Holder: Bronze.
- i. Disc: PTFE.
- j. Gasket: Asbestos free.

2.4 IRON, GROOVED-END SWING CHECK VALVES

- A. Iron, Grooved-End Swing Check Valves, 300 CWP:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Anvil International/Smith-Cooper International; Tailwind Capital, LLC.</u>
 - b. <u>Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.</u>
 - c. <u>Victaulic Company</u>.
 - 2. Description:
 - a. CWP Rating: 300 psig (2070 kPa).
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring operated, ductile iron or stainless steel.

2.5 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

- A. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 150:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>APCO DeZurik Valve Co</u>.
 - b. Crispin Valve.
 - c. <u>Victaulic Company</u>.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: Bronze.
- B. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 150:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Crispin Valve</u>.
 - b. <u>KITZ Corporation</u>.
 - c. <u>Metraflex Company (The)</u>.
 - 2. Description:
 - a. Standard: MSS SP-125.

- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.
- C. Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat, Class 150:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. APCO DeZurik Valve Co.
 - b. <u>Val-Matic Valve & Manufacturing Corp.</u>
 - c. <u>Victaulic Company</u>.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: EPDM or NBR.
- D. Iron, Globe, Center-Guided Check Valves with Resilient Seat, Class 150:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. DFT Inc.
 - b. Flomatic Corporation.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM or NBR.

2.6 IRON, PLATE-TYPE CHECK VALVES

- A. Iron, Dual-Plate Check Valves with Metal Seat, Class 150:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. APCO DeZurik Valve Co.
 - b. Metraflex Company (The).
 - c. Stockham; a Crane Co. brand.
 - 2. Standard: API 594.
 - 3. CWP Rating: 300 psig (2070 kPa).
 - 4. Body Design: Wafer, spring-loaded plates.
 - 5. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - 6. Seat: Bronze.

- B. Iron, Single-Plate Check Valves with Resilient Seat, Class 125:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>GA Industries, Inc.</u>
 - b. <u>Jomar Valve</u>.
 - c. Keckley Company.
 - 2. Standard: API 594.
 - 3. CWP Rating: 200 psig (1380 kPa).
 - 4. Body Design: Wafer, spring-loaded plate.
 - 5. Body Material: ASTM A 126, gray iron.
 - 6. Seat: EPDM or NBR.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Check Valves: Install check valves for proper direction of flow.
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
 - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded or soldered or press-ends.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged.
 - 7. For Grooved-End Copper Tubing and Steel Piping: Grooved.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze swing check valves with bronze disc, Class 150, with soldered or threaded end connections.
 - 2. Bronze swing check valves with press-end connections.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron swing check valves with metal seats, Class 125, with threaded or flanged end connections.
 - 2. Iron swing check valves with closure control lever and spring, Class 125, with threaded or flanged end connections.
 - 3. Iron, center-guided check valves with compact wafer, Class 125.
 - 4. Iron, center-guided check valves with globe, metal seat, Class 150, with threaded or flanged end connections.
 - 5. Iron, dual-plate check valves with metal seat, Class 150, with threaded or flanged end connections.
 - 6. Iron, single-plate check valves with resilient seat, Class 125, with threaded or flanged end connections.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Fiberglass pipe hangers.
- 4. Metal framing systems.
- 5. Fiberglass strut systems.
- 6. Thermal hanger-shield inserts.
- 7. Fastener systems.
- 8. Pipe stands.
- 9. Pipe-positioning systems.
- 10. Equipment supports.

B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- 2. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and
 cost.
 - 2. Environmental Product Declaration (EPD): For each product.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- 1. Detail fabrication and assembly of trapeze hangers.
- 2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe and Tube Hangers:

- 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
- 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 1 steel pipe hanger, except hanger is made of fiberglass or fiberglass-reinforced resin.
 - 2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel.
 - 3. Flammability: ASTM D635, ASTM E84, UL 94.
- B. Strap-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger, except hanger is made of fiberglass-reinforced resin.
 - a. Flammability: ASTM D635, ASTM E84, UL 94.
 - 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.5 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Cooper B-line; brand of Eaton, Electrical Sector.</u>
 - b. Unistrut; Atkore International.
 - c. Wesanco, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
 - 8. Metallic Coating: Pregalvanized G90 (Z275).
- B. Non-MFMA Manufacturer Metal Framing Systems:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Anvil International/Smith-Cooper International; Tailwind Capital, LLC.</u>

- b. MIRO Industries.
- c. Sioux Chief Manufacturing Company, Inc.
- 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
- 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
- 5. Channel Width: Select for applicable load criteria.
- 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- 8. Metallic Coating: Pregalvanized G90 (Z275)

2.6 FIBERGLASS STRUT SYSTEMS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Champion Fiberglass, Inc.
 - 2. G-Strut.
 - 3. Unistrut; Atkore International.
- B. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.
 - 1. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 2. Channels: Continuous slotted fiberglass-reinforced plastic channel with inturned lips.
 - 3. Channel Width: Selected for applicable load criteria.
 - 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 - Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
 - 6. Rated Strength: Selected to suit applicable load criteria.
 - 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.7 THERMAL HANGER-SHIELD INSERTS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. National Pipe Hanger Corporation.
 - 2. <u>Pipe Shields Inc.</u>
 - 3. Rilco Manufacturing Co., Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig (688-kPa) or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - MKT Fastening, LLC.
 - 2. Indoor and Outdoor Applications: stainless steel.

2.9 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.10 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.11 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.12 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M).

- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus [200 lb (90 kg)] <Insert value>.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Powder Actuated Concrete Fasteners
 - Obtain written approval from the structural engineer before using powder-actuated concrete fasteners.
 - 2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Suspension From Metal Decking
 - 1. Do not use metal decking for suspension of piping, ductwork or equipment. Hang items from top member of joist or provide additional structure to span between top members if needed.
- D. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- E. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

- F. Metal or Fiberglass Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- G. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- H. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- I. Pipe Stand Installation:
 - 1. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- J. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- K. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- L. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- M. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- N. Install lateral bracing with pipe hangers and supports to prevent swaying.
- O. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- P. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- Q. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- R. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - Use materials and methods that minimize distortion and develop strength and corrosion resistance
 of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C) pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.

- 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
- 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
- 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
- 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
- 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
- 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
- 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
- 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
- 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction occurs.
- 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction occurs.
- 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches (150 mm) for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 - 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

- 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
- 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Equipment labels.
- 2. Warning signs and labels.
- 3. Warning tape.
- 4. Pipe labels.
- 5. Stencils.
- 6. Underground-Type Plastic Line Marker.
- 7. Utility Service Markers
- 8. Ceiling Identification Discs
- 9. Valve tags.
- 10. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve-numbering scheme.
- D. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Brady Corporation</u>.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. <u>Seton Identification Products; a Brady Corporation company.</u>
 - 2. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

- 5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 6. Fasteners: Stainless steel rivets or self-tapping screws.
- 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. <u>Seton Identification Products</u>; a Brady Corporation company.
- 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, with predrilled holes for attachment hardware.
- 3. Letter and Background Color: As indicated for specific application under Part 3.
- 4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F (71 deg C).
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 7. Fasteners: Stainless steel self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. <u>Carlton Industries, LP.</u>
 - 4. <u>Seton Identification Products; a Brady Corporation company.</u>
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Brady Corporation</u>.
 - 2. Brimar Industries, Inc.
 - 3. <u>Seton Identification Products; a Brady Corporation company.</u>
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch (0.12 mm).
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F (70 deg C).
- G. Minimum Width: 4 inches (100 mm).

2.4 PIPE LABELS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
 - 2. Brady Corporation.
 - 3. <u>Brimar Industries, Inc.</u>
 - 4. Carlton Industries, LP.
 - 5. <u>Seton Identification Products; a Brady Corporation company.</u>
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

- A. Stencils for Piping:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brimar Industries, Inc.
 - b. <u>Craftmark Pipe Markers</u>.
 - c. Kolbi Pipe Marker Co.
 - d. Marking Services Inc.
 - 2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
 - 3. Stencil Material: Aluminum, brass, or fiberboard.
 - 4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 5. Identification Paint: Exterior, alkyd enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 6. Letter and Background Color: As indicated for specific application under Part 3.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKERS:

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
- B. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.7 UTILITY SERVICE MARKERS:

- A. Markers shall consist of bronze plates, ground and polished, and marked to identify the service. Markers shall also be stamped with arrows indicating the direction the service extends. A typical marker detail is shown on the Drawings.
- B. Markers locating services at the building shall be installed in masonry or concrete walls 2' above grade. Markers locating services elsewhere on the site shall be installed in concrete walks or curbs, or in 6" x 6" steel reinforced concrete posts as detailed.

2.8 MARKERS FOR IDENTIFYING EQUIPMENT ABOVE CEILINGS:

A. Provide manufacturer's standard laminated plastic, color-coded equipment markers for identifying type and location of mechanical equipment above suspended ceilings. Provide markers with pressure adhesive and

engraved as scheduled in this section. Markers shall be narrow enough to fit on exposed ceiling grid and long enough to accommodate specified engraving. Install on ceiling grid closest to equipment above ceiling.

2.9 VALVE TAGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Brady Corporation</u>.
 - 2. Brimar Industries, Inc.
 - 3. <u>Carlton Industries, LP.</u>
 - 4. <u>Seton Identification Products; a Brady Corporation company.</u>
- B. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.04-inch (1.0-mm) minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: BrassS-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

2.10 WARNING TAGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Brady Corporation</u>.
 - 2. <u>Brimar Industries, Inc.</u>
 - 3. <u>Seton Identification Products; a Brady Corporation company.</u>
- B. Description: Preprinted accident-prevention tags of plasticized card stock.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. (2 m) of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

- 1. Identification Paint: Use for contrasting background.
- 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. (1 m) of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. (1 m) of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. (8 m) along each run. Reduce intervals to 10 ft. (3 m) in areas of congested piping and equipment.
 - 5. Space every 10' in mechanical rooms.
- E. Provide piping identification markers in accordance with the following schedule. Provide black lettering on yellow and white backgrounds and white lettering on backgrounds with other colors.
- F. Piping Identification Schedule

| TYPE | OF SERVICE | MARKINGS | COLOR * | NO. * |
|------|-------------------------|--------------|-------------------|--------|
| 1. | DOMESTIC COLD WATER | D.C.W. SAI | FETY GREEN | SW4085 |
| 2. | DOMESTIC HOT WATER | D.H.W. | GREEN BYTE | SW4076 |
| 3. | MED. TEMP. HOT WATER | M.T.H.W. | SAFETY YELLOW | SW4084 |
| 4. | (300 deg F or less) | | | |
| 5. | MED. TEMP. H.W. RETURN | M.T.H.W.R. | SAFETY YELLOW | SW4084 |
| 6. | (300 deg F or less) | | | |
| 7. | NATURAL GAS | GAS | DECK RED | SW4040 |
| 8. | SAFETY VALVE VENTS | S.V.V. | GALVANO | SW4027 |
| 9. | C.I SOIL WASTE & VENTS | W. & V. | . VACUUM BLACK | SW4032 |
| 10. | ROOF LEADERS | R.L. | GALVANO | SW4027 |
| 11. | SOFT WATER | S.W. | PILLAR WHITE | SW4029 |
| 12. | ELEVATOR OIL LINES | E.O.L. | GALVANO | SW4027 |
| 13. | CONDENSATE PUMP DISCHAR | GE COND.P.D. | GALVANO | SW4027 |
| 14. | SUMP PUMP DISCHARGE | S.PUMP DIS | S. GALVANO | SW4027 |
| 15. | FIRE SUPPRESSION- | FIRE | SAFETY RED | SW4081 |
| | SPRINKLER SYSTEM | | | |

- G. <u>NOTES</u>: * COLOR AND NUMBER ARE FROM THE SHERWIN WILLIAMS 4000 COLOR SELECTION GUIDE DATED 1999.
- H. PIPING IN ARCHITECTURAL AREAS ARE TO BE PAINTED PER THE ARCHITECT'S DIRECTION.
- I. PAINT ALL PIPING IN MECHANICAL AND CONDESTED SPACES ACCORDING TO THE SCHEDULED COLOR CODE.
- J. LABEL ALL PIPING SYSTEMS FOR TRACING AND IDENTIFICATION.
- K. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- L. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.6 UNDERGROUND PIPING IDENTIFICATION:

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 12" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.7 UTILITY SERVICE MARKERS

A. Install utility service markers where shown on plans.

3.8 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 - 1. Valve-Tag Size and Shape: 1-1/2 inches, round.
 - 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.
- C. Mount valve schedule frames and schedules in mechanical room.

3.9 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Storm-water piping exposed to freezing conditions.
 - 5. Roof drains and rainwater leaders.
 - 6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For adhesives, mastics, and sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aeroflex USA.
 - b. <u>Armacell LLC</u>.
 - c. K-Flex USA.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. <u>Knauf Insulation</u>.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. <u>Johns Manville</u>; a Berkshire Hathaway company.
- b. Knauf Insulation.
- c. Manson Insulation Inc.
- d. Owens Corning.
- 2. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Ramco Insulation, Inc.</u>
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ramco Insulation, Inc.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aeroflex USA.
 - b. <u>Armacell LLC</u>.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. K-Flex USA.
 - 2. <u>Adhesive</u>: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
 - 3. <u>Verify adhesives and sealants comply</u> with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
- 2. <u>Adhesive</u>: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
- 3. <u>Verify adhesives and sealants comply</u> with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
 - 2. <u>Verify adhesives have a VOC</u> content of 80 g/L or less.
 - 3. <u>Verify adhesives and sealants comply</u> with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Johns Manville</u>; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Speedline Corporation.
 - 2. <u>Adhesive</u>: As recommended by Adhesive PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
 - 3. <u>Verify adhesives and sealants comply</u> with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
 - 2. <u>Verify mastics comply with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. <u>Childers Brand; H. B. Fuller Construction Products.</u>
- b. Foster Brand: H. B. Fuller Construction Products.
- c. Knauf Insulation.
- d. <u>Vimasco Corporation</u>.
- 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
- 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
- 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Childers Brand; H. B. Fuller Construction Products.</u>
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. <u>Mon-Eco Industries, Inc.</u>
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. <u>Foster Brand; H. B. Fuller Construction Products.</u>
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. <u>Vimasco Corporation</u>.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

5. Color: White.

2.6 SEALANTS

A. Joint Sealants for Cellular-Glass Products:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Childers Brand; H. B. Fuller Construction Products.</u>
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Permanently flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
- 5. Color: White or gray.
- 6. <u>Verify sealant has a VOC</u> content of 420 g/L or less.
- 7. <u>Verify sealant complies with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Metal Jacket Flashing Sealants:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Childers Brand; H. B. Fuller Construction Products.</u>
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
- 5. Color: Aluminum.
- 6. <u>Verify sealant has a VOC</u> content of 420 g/L or less.
- 7. <u>Verify sealant complies with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Childers Brand; H. B. Fuller Construction Products.</u>
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
- 5. Color: White.
- 6. <u>Verify sealant has a VOC</u> content of 420 g/L or less.
- 7. <u>Verify sealant complies with the</u> testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Alpha Associates, Inc.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. <u>Proto Corporation</u>.
 - d. Speedline Corporation.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color-code jackets based on system. Color as selected by Architect.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.

- 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. <u>Avery Dennison Corporation, Specialty Tapes Division.</u>
 - c. <u>Ideal Tape Co., Inc., an American Biltrite Company</u>.
 - d. <u>Knauf Insulation</u>.
 - 2. Width: 3 inches (75 mm).
 - 3. Thickness: 11.5 mils (0.29 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - 2. Width: 2 inches (50 mm).
 - 3. Thickness: 6 mils (0.15 mm).
 - 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. <u>Avery Dennison Corporation, Specialty Tapes Division</u>.
 - c. <u>Ideal Tape Co., Inc., an American Biltrite Company</u>.
 - d. Knauf Insulation.
 - 2. Width: 2 inches (50 mm).
 - 3. Thickness: 3.7 mils (0.093 mm).
 - 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.11 SECUREMENTS

- A. Bands:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Johns Manville</u>; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. C & F Wire.
 - b. <u>Johns Manville</u>; a Berkshire Hathaway company.

c. RPR Products, Inc.

2.12 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. McGuire Manufacturing.
 - b. <u>Truebro</u>.
 - c. Zurn Industries, LLC.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainlesssteel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.

- 3. Nameplates and data plates.
- 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

- 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
- 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
- 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
- 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
- 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
- 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 - 4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of cellular-glass insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 - 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation
 - 4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 - Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vaporbarrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 (DN 25) and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
 - 2. NPS 1-1/42 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1½ inch thick.
 - 2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick.
- C. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1½ inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1½ inch thick.
- D. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1½ inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1½ inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be the following:
- F. Protective Shielding Pipe Covers Sanitary Waste Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.
- G. Floor Drains, Traps, and Sanitary Drain Piping of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch (19 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Exposed piping in any room and all piping in boiler, mechanical rooms, and tunnels shall have an 8 ounce canvas jacket applied over the fiberglass factory ASJ/SSL jacketing to further protect the insulation from abuse. This jacketing must be properly applied with lagging adhesive, such that the outer surface is smooth and free or wrinkles. The canvas jacketing in all mechanical areas is to be prepared for painting, and then painted according to the schedule included in specifications. All chilled water piping insulation shall be completely sealed so that a perfect vapor barrier is achieved.
- B. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- C. If more than one material is listed, selection from materials listed is Contractor's option.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 - 1. Painted Aluminum, Corrugated with Z-Shaped Locking Seam: 0.024 inch (0.61 mm) thick.

END OF SECTION 220719

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

1.3 **DEFINITIONS**

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
 - 1. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping..

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Application" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B88, Type K (ASTM B88M, Type A), water tube, annealed temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Hard Copper Tube: ASTM B88, Type L (ASTM B88M, Type B), water tube, drawn temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

- Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
- Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
 - 1. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - a. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - 2) Smith-Cooper International.
 - 3) <u>Victaulic Company</u>.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions matching pipe.
 - c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.4 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Deflection Fittings:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>EBAA Iron, Inc</u>.
 - b. <u>U.S. Pipe and Foundry Company</u>.
 - 2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - a. Pressure Rating: 250 psig (1725 kPa) minimum.

2.5 JOINING MATERIALS

- A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.6 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Cascade Waterworks Mfg. Co.</u>
 - b. Ford Meter Box Company, Inc. (The).
 - c. <u>Smith-Blair, a Xylem brand</u>.
 - 2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.
 - b. Center-Sleeve Material: Manufacturer's standard.
 - c. Gasket Material: Natural or synthetic rubber.
 - d. Pressure Rating: 150 psig (1035 kPa) minimum.
 - e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Victaulic Company</u>.
- 2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
 - a. Standard: AWWA C219.
 - b. Sleeve Material: Manufacturer's standard.
 - c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
 - d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
 - e. Pressure Rating: 150 psig (1035 kPa) minimum.
 - f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

- 1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
- 2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig (1035 kPa).

- 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 150 psig (1035 kPa).
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- 4. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig (1035 kPa).
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
- 5. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple complying with ASTM F1545.
 - 3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.7 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>American AVK Co</u>.
 - b. <u>American Cast Iron Pipe Company</u>.
 - c. <u>Mueller Co</u>.
 - d. NIBCO INC.
 - e. <u>Zurn Industries, LLC</u>.
 - 2. Nonrising-Stem, Metal-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

- 3. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
- 4. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
 - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 250 psig (1725 kPa).
 - 3) End Connections: Push on or mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
- 5. OS&Y, Rising-Stem, Metal-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Flanged.
- 6. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Flanged.
- B. UL/FMG, Cast-Iron Gate Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Mueller Co</u>.
 - b. NIBCO INC.
 - c. <u>Zurn Industries, LLC</u>.
 - 2. UL/FMG, Nonrising-Stem Gate Valves:
 - Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
 - 3) End Connections: Flanged.

- 3. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
 - 3) End Connections: Flanged.

C. Bronze Gate Valves:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; a Crane Co. brand.
 - b. <u>Hammond Valve</u>.
 - c. <u>Milwaukee Valve Company</u>.
 - d. NIBCO INC.
 - e. <u>Red-White Valve Corp.</u>
- 2. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Bronze body and bonnet and bronze stem.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
 - 3) End Connections: Threaded.
- 3. Nonrising-Stem Gate Valves:
 - a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - 1) Standard: MSS SP-80.

2.8 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Cast Iron Pipe Company.
 - b. <u>Kennedy Valve Company</u>; a division of McWane, Inc.
 - c. <u>U.S. Pipe and Foundry Company</u>.
 - 2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, metal-seated gate valve with one raised face flange mating tapping-sleeve flange.

- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.9 CHECK VALVES

- A. AWWA Check Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. APCO DeZurik Valve Co.
 - b. <u>Mueller Co</u>.
 - c. NIBCO INC.
 - 2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Pressure Rating: 175 psig (1207 kPa).
- B. UL/FMG, Check Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Mueller Co</u>.
 - b. NIBCO INC.
 - c. Reliable Automatic Sprinkler Co., Inc. (The).
 - 2. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.
 - a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: 175 psig (1207 kPa).

2.10 DETECTOR CHECK VALVES

- A. Detector Check Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ames Fire & Waterworks; A WATTS Brand.
 - b. FEBCO; A WATTS Brand.
 - c WATTS
 - 2. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and

replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.

- a. Standards: UL 312 and FMG approved.
- b. Pressure Rating: 175 psig (1207 kPa).
- c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.
- 3. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.
 - a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: 175 psig (1207 kPa).

2.11 BUTTERFLY VALVES

- A. AWWA Butterfly Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>DeZURIK/APCO/Hilton</u>.
 - b. <u>Mueller Co</u>.
 - 2. Description: Rubber seated.
 - a. Standard: AWWA C504.
 - b. Body: Cast or ductile iron.
 - c. Body Type: [Wafer] [Wafer or flanged] [Flanged].
 - d. Pressure Rating: 150 psig (1035 kPa).
- B. UL Butterfly Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Kennedy Valve Company; a division of McWane, Inc.
 - b. NIBC<u>O INC</u>.
 - 2. Description: Metal on resilient material seating.
 - a. Standards: UL 1091 and FMG approved.
 - b. Body: Cast or ductile iron.
 - c. Body Type: Flanged.
 - d. Pressure Rating: 175 psig (1207 kPa).

2.12 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.Y. McDonald Mfg. Co.

- b. Ford Meter Box Company, Inc. (The).
- c. Mueller Co.
- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.13 WATER METERS

A. Furnish and/or install water meter as required by local utility company.

2.14 VACUUM BREAKERS

- A. Pressure Vacuum Breaker Assembly:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. <u>WATTS</u>.
 - c. <u>Zurn Industries, LLC</u>.
 - 2. Standard: ASSE 1020.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
 - 5. Accessories: Ball valves on inlet and outlet.

2.15 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. Zurn Industries, LLC.

- 2. Standard: ASSE 1013 or AWWA C511.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
- 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
- 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
- 7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Double-Check, Detector-Assembly Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standards: ASSE 1048 and UL listed or FMG approved.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
 - 5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
 - 6. End Connections: Flanged.
 - 7. Accessories:
 - a. Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- C. Backflow Preventer Test Kits:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. <u>WATTS</u>.
 - c. Zurn Industries, LLC.
 - 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.16 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C857 and made according to ASTM C858.
 - 1. Ladder: ASTM A36/A36M, steel or polyethylene-encased steel steps.
 - 2. Manhole: ASTM A536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - a. Dimension: 24-inch- (610-mm-) minimum diameter, unless otherwise indicated.

3. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.17 FIRE HYDRANTS

- A. Dry-Barrel Fire Hydrants:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Clow Valve Company; a subsidiary of McWane, Inc.</u>
 - b. <u>Kennedy Valve Company</u>; a division of McWane, Inc.
 - c. Mueller Co.
 - 2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standards: UL 246, FMG approved.
 - b. Pressure Rating: 150 psig (1035 kPa) minimum.
 - c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
 - e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
 - f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

2.18 FIRE DEPARTMENT CONNECTIONS

- A. Fire Department Connections:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Elkhart Brass Mfg. Co., Inc.</u>
 - b. <u>Guardian Fire Equipment, Inc.</u>
 - e. Potter Roemer LLC; a Division of Morris Group International.
 - 2. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.
 - a. Standard: UL 405.
 - b. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 4 (DN 100) outlet.
 - c. Inlet Alignment: Inline, horizontal.
 - d. Finish Including Sleeve: Polished chrome-plated.
 - e. Escutcheon Plate Marking: "AUTO SPKR."

2.19 ALARM DEVICES

- A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig (1725-kPa) working pressure; designed for horizontal or vertical installation; with 2 single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be the following:
 - 1. Soft copper tube, ASTM B88, Type K (ASTM B88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
- F. Underground water-service piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be the following:
 - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
- G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 (DN 20 to DN 50) shall be same as underground water-service piping.
- H. Aboveground and Vault Water-Service Piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be the following:
 - 1. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and brazed joints.

- I. Aboveground and vault water-service piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be any of the following:
 - 1. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
- J. Underground Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be the following:
 - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
- K. Aboveground and Vault Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- L. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be the following:
 - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
- M. Aboveground and Vault Combined Water Service and Fire-Service-Main Piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, metal-seated gate valves with valve box.
 - 2. Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
 - 3. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 2 (DN 50) and Smaller: Bronze, rising stem.
 - b. Gate Valves, NPS 3 (DN 80) and Larger: UL/FMG, cast iron, OS&Y rising stem.
 - c. Check Valves: UL/FMG, swing type.
 - 4. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main and/or arrange for tap according to requirements of water utility company and of size and in location indicated.
- B. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - 1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- F. Bury piping with depth of cover over top at least 42 inches, with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:
 - 1. Under Driveways: With at least 42 inches (910 mm) cover over top.
 - 2. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) additional cover.
- G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed.

 Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- I. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- J. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- K. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- L. See Section 211313 "Wet-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

M. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with maximum spacing and minimum rod diameters to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- E. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 **JOINT CONSTRUCTION**

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 - 3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 4. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - a. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
 - b. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
 - c. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.8 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.

- 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.9 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.10 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.11 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

3.12 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.13 VACUUM BREAKER ASSEMBLY INSTALLATION

- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.14 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.15 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top 2 inches (50 mm) above surface.

3.16 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C891.

3.17 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.18 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire department connection to mains.
- B. Install protective pipe bollards on two sides of each fire department connection.

3.19 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.

- 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve voke.
- 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
 - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Section 284621.11 "Addressable Fire-Alarm Systems" and Section 284621.13 "Conventional Fire-Alarm Systems."

3.20 CONNECTIONS

- A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve or service clamp and corporation valve.
- C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.21 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.22 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping.

3.23 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - c. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Ductile-iron pipe and fittings.
 - 3. Piping joining materials.
 - 4. Transition fittings.
 - 5. Dielectric fittings.
- B. Related Requirements:
 - 1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Pipe and tube.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Transition fittings.
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For adhesives, indicating VOC content.

Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

- 2. <u>Environmental Product Declaration</u>: For each product.
- 3. Health Product Declaration: For each product.
- 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Owner's written permission.

1.6 WARRANTY

- A. Victaulic Inspection Services and Warranty.
 - 1. Base Version:
 - a. The installing contractor shall be certified by the grooved coupling manufacturer. A Victaulic factory trained representative (direct employee) shall provide on-site certification training for the contractor's field personnel in the use of grooving tools, application of groove, and product installation. Applicable pipe shall be grooved utilizing Victaulic RG5200i grooving machine. A manufacturer's factory trained inspector shall visit the job site and review grooved joint products installation. The installing contractor shall remove and replace any improperly installed products. Upon completion of the manufacturer's inspection of the installation, the manufacturer will supply the owner and engineer with an inspection log and subsequent extended ten-year warranty on the inspected products.

2. Extended Version:

- a. Tooling:
 - 1) Applicable pipe shall be grooved utilizing Victaulic automated roll grooving tool (RG5200i). Documented grooving dimensions shall be given to engineer/owner at their request.
- b. Training
 - 1) A Victaulic factory trained representative (direct employee) shall provide on-site training for the contractor's field personnel in the use of grooving tools, application of groove, and product installation.
- c. Inspection
 - 1) A manufacturer's factory trained inspector shall visit the job site and review all grooved joint product installation. The products must be inspected prior to insulation being applied and is contractor's responsibility to coordinate with manufacture. The installing contractor shall remove and replace any improperly installed products.
- d. Warranty
 - 1) Upon completion of the manufacturer's inspection of the installation, the manufacturer will supply the owner with an extended ten-year warranty on the inspected products.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L (ASTM B88M, Type B).
- B. Annealed-Temper Copper Tube: ASTM B88, Type K (ASTM B88M, Type A).
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Wrought Copper Unions: ASME B16.22.
- H. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>T-DRILL Industries Inc.</u>
 - 2. Description: Tee formed in copper tube in accordance with ASTM F2014.
- I. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. <u>Victaulic Company</u>.
 - 2. Grooved-End, Copper Fittings: ASTM B75 (ASTM B75M) copper tube or ASTM B584 bronze castings.
 - 3. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, EPDM-rubber gasket, UL classified per NSF 61 and NSF 372, and rated for minimum 180 deg F (80 deg C), for use with ferrous housing and steel bolts and nuts; 300 psig (2060 kPa)minimum CWP pressure rating.
 - 4. Grooved-End Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves. Gasket shall be Grade "P" fluoroelastomer compound designed for potable water service. Couplings shall be Victaulic Style 607 and Butterfly Valve Victaulic Style 608N. If contractor elects to use stainless steel, Victaulic style 889 Couplings may be utilized in conjunction with Style 861 Butterfly Valve.
 - 5. Victaulic grooved style 607N rigid couplings and fittings

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
 - AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C153/A21.53, ductile iron.
 - Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
- E. Appurtenances for Grooved-End, Ductile-Iron Pipe:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Shurjoint; a part of Aalberts Integrated piping Systems.
 - b. Smith-Cooper International.
 - c. Victaulic Company.
 - 2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions that match pipe.
 - 3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
 - a. AWWA C606 for ductile-iron-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) NPS 14 to NPS 18 (DN 350 to DN 450): 250 psig (1725 kPa).
 - 2) NPS 20 to NPS 46 (DN 500 to DN 900): 150 psig (1035 kPa).

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Cascade Waterworks Mfg. Co</u>.
 - b. Dresser, Inc.
 - c. Ford Meter Box Company, Inc. (The).
 - d. Jay R. Smith Mfg Co; a division of Morris Group International.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 150 psig (1035 kPa).
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>WATTS</u>.
 - b. Wilkins.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1079.

- 3. Factory-fabricated, bolted, companion-flange assembly.
- 4. Pressure Rating: 150 psig (1035 kPa).
- End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, LLC.
 - b. Calpico, Inc.
 - c. <u>GPT</u>; a division of EnPRO Industries.
- 2. Nonconducting materials for field assembly of companion flanges.
- 3. Pressure Rating: 150 psig (1035 kPa).
- 4. Gasket: Neoprene or phenolic.
- 5. Bolt Sleeves: Phenolic or polyethylene.
- 6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Victaulic Company.
- 2. Standard: IAPMO PS 66.
- 3. Electroplated steel nipple complying with ASTM F1545.
- 4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- 5. End Connections: Male threaded or grooved.
- 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller, shall be the following:
 - 1. Annealed-temper copper tube, ASTM B88, Type K (ASTM B88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.

- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300), shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
- G. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
 - 1. annealed-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and brazed joints.
- H. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); cast- or wrought-copper, solder-joint fittings; and soldered joints.
- I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); grooved-joint, coppertube appurtenances; and grooved joints.
- J. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be[one of] the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B); grooved-joint, coppertube appurtenances; and grooved joints.
- K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to (DN 300), shall be the following:
 - 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install duetile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install valves according to the following:

- 1. Section 220523.12 "Ball Valves for Plumbing Piping."
- 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
- 3. Section 220523.14 "Check Valves for Plumbing Piping."
- E. Install domestic water piping level without pitch and plumb.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."
- P. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- Q. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Grooved Joining Method. Assemble joints with coupling and gasket, lubricant and bolts. Cut or Roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions, which may or may not include torque settings, torque wrenches, extreme lubricant and specified gaps. Engineer and Owner reserve the right to inspect any and all installation of product. Factory trained representative must periodically visit the job site and provide on-site training. Grooved pipe shall be produced using the Victaulic RG5200i/5200i fully automated grooving tool, where applicable, that provides groove traceability documents, corresponding identification marks on the pipe, and confirm all critical dimensions fall into the required tolerance range as listed by the tool manufacturer.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper and ductile iron tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches (300 mm) of each fitting.
- D. Support vertical runs of copper and ductile iron tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.

- 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
- 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean and disinfect domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

- 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Temperature-actuated, water mixing valves.
 - 5. Strainers.
 - 6. Outlet boxes.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water-hammer arresters.
 - 11. Trap-seal primer valves.
 - 12. Flexible connectors.

B. Related Requirements:

- 1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
- 2. Section 221116 "Domestic Water Piping" for water meters.
- 3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
- 4. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.
- C. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For water consumption.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61.
- B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 (860) psig (kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. WATTS.
 - b. Woodford Manufacturing Company.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
- b. WATTS.
- c. Zurn Industries, LLC.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 (35) psig (kPa) maximum, through middle third of flow range.
- 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 12 (83) psig (kPa) maximum, through middle third of flow range.
 - 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
 - 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 - 7. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1015.
 - 3. Operation: Continuous-pressure applications unless otherwise indicated.
 - 4. Pressure Loss: 5 (35) psig (kPa) maximum, through middle third of flow range.
 - 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
 - 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 - 7. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

- C. Beverage-Dispensing-Equipment Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1022.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
 - 5. Body: Stainless steel.
 - 6. End Connections: Threaded.
- D. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. WATTS.
 - 2. Standard: ASSE 1032.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10).
 - 5. Body: Stainless steel.
 - 6. End Connections: Threaded.
- E. Double-Check, Detector-Assembly Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. <u>Zurn Industries, LLC</u>.
 - 2. Standard: ASSE 1048 and is FM Global approved or UL listed.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 (35) psig (kPa) maximum, through middle third of flow range.
 - 5. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved.
 - 6. End Connections: Flanged.
 - 7. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- F. Hose-Connection Backflow Preventers:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. WATTS
 - b. Woodford Manufacturing Company.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1052.

- 3. Operation: Up to 10-foot head of water (30-kPa) back pressure.
- 4. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
- 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
- 6. Capacity: At least 3-gpm (0.19-L/s) flow.
- G. Backflow-Preventer Test Kits:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 - 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - Bell & Gossett; a Xylem brand.
 - b. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
 - c. <u>NIBCO INC</u>.
 - d. WATTS.
 - 2. Type: Y-pattern globe valve with two readout ports and memory-setting indicator.
 - 3. Body: Brass or bronze.
 - 4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Cast-Iron Calibrated Balancing Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Armstrong International</u>, Inc.
 - b. ITT Corporation.
 - c. NIBCO INC.
 - d. WATTS.
 - 2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 - 3. Size: Same as connected piping, but not smaller than NPS 2-1/2 (DN 65).
- C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Acorn Engineering Company; a Division of Morris Group International.
- b. <u>Lawler Manufacturing Company, Inc.</u>
- c. <u>Leonard Valve Company</u>.
- d. POWERS; A WATTS Brand.
- e. WATTS.
- f. Zurn Industries, LLC.
- 2. Standard: ASSE 1017.
- 3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
- 4. Type: Exposed-mounted or Cabinet-type, thermostatically controlled, water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: Threaded union inlets and outlet.
- 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
- 8. Valve Finish: Chrome plated.
- 9. Piping Finish: Copper.
- 10. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
- B. Manifold, Thermostatic, Water Mixing-Valve Assemblies:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Leonard Valve Company</u>.
 - b. POWERS; A WATTS Brand.
 - c. Symmons Industries, Inc.
 - 2. Description: Factory-fabricated, cabinet-type or exposed-mounted, thermostatically controlled, water mixing-valve assembly in two-valve parallel arrangement.
 - 3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
 - 4. Small-Flow Parallel: Thermostatic, water mixing valve.
 - 5. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
 - 6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
 - 7. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
 - 8. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
 - 9. Thermostatic Mixing Valve and Water Regulator Finish: Chrome plated.
 - 10. Piping Finish: Copper.
- C. Individual-Fixture, Water Tempering Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. POWERS; A WATTS Brand.
 - 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
 - 3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
 - 4. Body: Bronze body with corrosion-resistant interior components.
 - 5. Temperature Control: Adjustable.
 - 6. Inlets and Outlet: Threaded.
 - 7. Finish: Rough or chrome-plated bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
- 2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
- 3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
- 4. Screen: Stainless steel with round perforations unless otherwise indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 (0.51) inch (mm).
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 (1.14) inch (mm).
 - c. Strainers NPS 5 (DN 125) and Larger: 0.10 (2.54) inch (mm).
- 6. Drain: Factory-installed, hose-end drain valve.

2.8 OUTLET BOXES

A. Icemaker Outlet Boxes:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Guy Gray, IPS Corporation.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
- 2. Mounting: Recessed.
- 3. Material and Finish: Stainless-steel box and faceplate.
- 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 (DN 15) or smaller copper tube outlet.
- 5. Supply Shutoff Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.

2.9 HOSE BIBBS

A. Hose Bibbs:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. <u>WATTS</u>.
 - c. <u>Woodford Manufacturing Company</u>.
 - d. Zurn Industries, LLC.
- 2. Standard: ASME A112.18.1 for sediment faucets.
- 3. Body Material: Bronze.
- 4. Seat: Bronze, replaceable.
- 5. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
- 6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
- 7. Pressure Rating: 125 psig (860 kPa).

- 8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
- 9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
- 10. Finish for Service Areas: Chrome or nickel plated.
- 11. Finish for Finished Rooms: Chrome or nickel plated.
- 12. Operation for Equipment Rooms: Wheel handle or operating key.
- 13. Operation for Service Areas: Operating key.
- 14. Operation for Finished Rooms: Operating key.
- 15. Include operating key with each operating-key hose bibb.
- 16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS.
 - c. Woodford Manufacturing Company.
 - d. <u>Zurn Industries, LLC</u>.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
- 3. Pressure Rating: 125 psig (860 kPa).
- 4. Operation: Loose key.
- 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
- 6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
- 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 8. Box: Deep, flush mounted with cover.
- 9. Box and Cover Finish: Polished nickel bronze.
- Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
- 12. Operating Keys(s): One with each wall hydrant.

2.11 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 - 2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
 - 3. Size: NPS 3/4 (DN 20).
 - 4. Body: Copper alloy.
 - 5. Ball: Chrome-plated brass.
 - 6. Seats and Seals: Replaceable.
 - 7. Handle: Vinyl-covered steel.
 - 8. Inlet: Threaded or solder joint.
 - 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Jay R. Smith Mfg Co; a division of Morris Group International.</u>
 - b. <u>Josam Company</u>.
 - c. <u>Sioux Chief Manufacturing Company, Inc.</u>
 - d. WATTS.
 - e. <u>Zurn Industries, LLC</u>.
 - 2. Standard: ASSE 1010 or PDI-WH 201.
 - 3. Type: Metal bellows.
 - 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

2.14 TRAP-SEAL PRIMER SYSTEMS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Precision Plumbing Products, Inc. "Oregon #1".
 - 2. Sioux Chief Manufacturing Company, Inc.
- B. ASSE 1018, water-supply-fed type, with the following characteristics:
 - 1. 35 to 75-psig operating range.
 - 2. Dacovin 4051A body with vacuum breaker and backflow preventer.
 - 3. Inlet and Outlet Connections: 1/2-inch threaded, union, or solder joint.
 - 4. Finish: Chrome plated, or rough brass for units used with pipe or tube that is not chrome finished.
- C. Provide distribution units as required so that anywhere from 1 to 8 floor drain traps can be served from 1 trap primer.

2.15 FLEXIBLE CONNECTORS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Flex-Hose Co., Inc.</u>
 - 2. Mason Industries, Inc.
 - 3. Metraflex Company (The).
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Balancing Valves: Install in locations where they can easily be adjusted.
- C. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Y-Pattern Strainers: For water, install on supply side of each control valve and pump.
- E. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- F. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.
- G. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

- 1. Pressure vacuum breakers.
- 2. Reduced-pressure-principle backflow preventers.
- 3. Double-check, backflow-prevention assemblies.
- 4. Carbonated-beverage-machine backflow preventers.
- 5. Dual-check-valve backflow preventers.
- 6. Double-check, detector-assembly backflow preventers.
- 7. Calibrated balancing valves.
- 8. Primary, thermostatic, water mixing valves.
- 9. Primary water tempering valves.
- 10. Outlet boxes.
- 11. Supply-type, trap-seal primer valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123.21 - INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For pump controls.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components Health Effects and Drinking Water System Components Lead Content Compliance: NSF 61 and NSF 372.

2.2 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
- B. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Bell & Gossett; a Xylem brand.</u>
 - 2. Taco Comfort Solutions.
 - 3. Thrush Co. Inc.

C. Pump Construction:

- 1. Casing:
 - a. Radially split with threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections.
 - b. Built to permit servicing of pump internals without disturbing the casing or the suction and discharge piping.
 - c. Gauge port tappings at suction and discharge nozzles.
- 2. Impeller: Bronze or brass, statically and dynamically balanced, closed, and keyed to shaft.
- 3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
- 4. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- 5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
- 6. Bearings: Grease-lubricated or permanently lubricated ball type.
- 7. Minimum Working Pressure: 175 psig (1200 kPa).
- 8. Continuous Operating Temperature: 225 deg F (107 deg C).
- D. Motor: Single speed, with grease-lubricated ball bearings; resiliently or rigidly mounted to pump casing.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

A. Interlock with Building Management System as shown in sequence of operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
 - 1. Comply with requirements for vibration isolation devices Fabricate brackets or supports as required.
 - 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- D. Install pressure switches in water-supply piping.
- E. Install thermostats in hot-water return piping.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - b. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:

- 1. Section 220523.12 "Ball Valves for Plumbing Piping."
- 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
- 3. Section 220523.14 "Check Valves for Plumbing Piping."
- 4. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.

- 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- 6. Start motor.
- 7. Open discharge valve slowly.
- 8. Adjust temperature settings on thermostats.
- 9. Adjust timer settings.

3.8 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Ductile-iron, gravity sewer pipe and fittings.
 - 3. Nonpressure-type transition couplings.
 - 4. Cleanouts.
 - 5. Manholes.
 - 6. Concrete.

1.3 **DEFINITIONS**

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fittings.
 - 2. Non-pressure and pressure couplings
 - 3. Cleanouts.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of pipe and fitting.
- B. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Handle manholes according to manufacturer's written rigging instructions.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.2 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

- A. Pipe: ASTM A 746, for push-on joints.
- B. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153/A21.53, ductile iron, for push-on joints.
- D. Gaskets: AWWA C111/A21.11, rubber.

2.3 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2. For Dissimilar Pipes: ASTM D 5926 or other material compatible with pipe materials being joined.
- C. Shielded, Flexible Couplings:
 - 1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 2. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Cascade Waterworks Mfg. Co</u>.
 - b. Dallas Specialty & Mfg. Co.
 - c. Mission Rubber Company, LLC; a division of MCP Industries.
- D. Ring-Type, Flexible Couplings:

- 1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
- 2. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Fernco Inc.
 - b. <u>Logan Clay Pipe</u>.
 - c. <u>Mission Rubber Company, LLC; a division of MCP Industries.</u>

2.4 CLEANOUTS

A. Cast-Iron Cleanouts:

- 1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
- 2. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. <u>Josam Company</u>.
 - c. <u>Tyler Pipe</u>; a subsidiary of McWane Inc.
 - d. WATTS.
 - e. <u>Zurn Industries, LLC</u>.
- 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 MANHOLES

A. Standard Precast Concrete Manholes:

- 1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
- 2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
- 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
- 4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
- 5. Riser Sections: 4-inch (100-mm) minimum thickness, of length to provide depth indicated.
- 6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
- 7. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
- 8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
- 9. Steps: ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
- 10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

- 11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
- B. Manhole Frames and Covers:
 - 1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser, with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
 - 2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.6 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, ACI 350 (ACI 350M), and the following:
 - 1. Cement: ASTM C 150/C 150M, Type II.
 - 2. Fine Aggregate: ASTM C 33/C 33M, sand.
 - 3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420-MPa) deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 1 percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 4 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420-MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 - 2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install piping with 36-inch (915-mm) minimum cover.
 - 4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 - 5. Install ductile-iron, gravity sewer piping according to ASTM A 746.
- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - 2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
 - 3. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
 - 4. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.
- B. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Shielded flexible or rigidcouplings for pipes of same or slightly different OD.

- b. Unshielded, increaser/reducer-pattern, flexible or rigidcouplings for pipes with different OD.
- c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

- 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
 - Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
- 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to grease interceptors specified in Section 221323 "Sanitary Waste Interceptors."

3.8 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch- (203-mm-) thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
 - 1. Remove manhole and close open ends of remaining piping.
 - 2. Remove top of manhole down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to contract documents.

3.9 IDENTIFICATION

- A. Comply with requirements in contract documents for underground utility identification devices.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
- c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
- d. Infiltration: Water leakage into piping.
- e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least 10-foot (3-m) head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 - 6. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 **DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.6 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.7 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

- a. Available Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
- C. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, Type M (Type C); copper pressure fittings; and soldered joints.

- D. Underground, soil and waste piping shall be any of the following:
 - 1. Hub-and-spigot, cast iron
 - 2. Copper DWV tube, copper drainage fittings, and soldered joints."

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- C. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- D. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:

- 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers. a.
- b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
- c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
- Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. 3. Support pipe rolls on trapeze.
- Base of Vertical Piping: MSS Type 52, spring hangers. 4.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum E. rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2.. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
- F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod. 2.
 - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- G. Install supports for vertical copper tubing every 10 feet (3 m).
- Η. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 **CONNECTIONS**

6.

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- Connect drainage and vent piping to the following: B.
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Miscellaneous sanitary drainage piping specialties.

1.3 **DEFINITIONS**

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Jay R. Smith Mfg Co; a division of Morris Group International.</u>
 - b. <u>Josam Company</u>.
 - c. <u>Tyler Pipe</u>; a subsidiary of McWane Inc.
 - d. Watts.
 - e. Zurn Industries, LLC.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. <u>Josam Company</u>.
 - c. Watts.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected branch.
 - 4. Body or Ferrule: Cast iron.
 - 5. Riser: ASTM A74, Cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. Watts.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: As required to match connected piping.
 - 5. Closure Plug:
 - a. Drilled and threaded for cover attachment screw.
 - b. Size: Same as or not more than one size smaller than cleanout size.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

- 1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
- 2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

- 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
- 2. Size: Same as connected waste piping.
 - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

- 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
- 2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

D. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Assemble open drain fittings and install with top of hub1 inch (25 mm) above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.

- F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install wood-blocking reinforcement for wall-mounting-type specialties.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Floor drains.
 - 2. Trench drains.
 - 3. Channel drainage systems.

1.3 **DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Floor Drains: See drawings.

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2.3 TRENCH DRAINS

A. Trench Drains: See drawings.

2.4 CHANNEL DRAINAGE SYSTEMS

A. Channel Drainage Systems: See drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 - 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 - 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
 - 1. Set grates of drains flush with finished surface, unless otherwise indicated.
- C. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.
 - 1. Install on support devices, so that top will be flush with adjacent surface.
- Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.
- E. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.
- F. Install open drain fittings with top of hub 2 inches (51 mm) above floor.

SANITARY DRAINS 221319.13 - 2

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for and miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

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SECTION 221329 - SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submersible sewage pumps.
 - 2. Sewage-pump basins and basin covers.
- B. Related Sections include the following:
 - 1. Section 221429 "Sump Pumps" for applications in storm-drainage systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SEWAGE PUMPS

- A. Submersible, Quick-Disconnect, Double-Seal Sewage Pumps:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a.
 - b. Weil Pump Company, Inc.
 - c. Weinman Division; Crane Pumps & Systems.
 - d. Zoeller Company.
 - 2. Description: Factory-assembled and -tested sewage-pump unit with guide-rail supports.
 - 3. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 - 4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
 - 5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
 - 6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
 - 7. Seals: Mechanical.
 - 8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 - 9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

10. Controls:

- a. Enclosure: NEMA 250, Type 1.
- b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
- e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

12. Guide-Rail Supports:

a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."

- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

2.2 SEWAGE-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 - 1. Material: Fiberglass.
 - 2. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports if used, and accessories.
 - 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.3 INSTALLATION

- A. Pump Installation Standards:
 - 1. Comply with HI 1.4 for installation of centrifugal pumps.
- B. Equipment Mounting:
 - 1. Install progressing-cavity sewage pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in contract documents.
- C. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221329

SECTION 221413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following storm drainage and overflow piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. This Section also includes connecting to exterior storm sewers.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water (30 kPa).
 - 2. Storm Drainage, Force-Main Piping: 50 psig (345 kPa).

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesive primers, documentation including printed statement of VOC content.
- C. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with Kentucky State Plumbing Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
- C. Pressure Fittings:
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.22, wrought-copper, solder-joint fittings.
 - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch (0.10-mm) or LLDPE film of 0.008-inch (0.20-mm) minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground storm drainage piping, all sizes, shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Copper DWV tube, copper drainage fittings, and soldered joints.
- C. Underground storm drainage piping, all sizes, shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints and film encasement.
- D. Aboveground storm drainage force mains, all sizes, shall be any of the following:
 - 1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 2. Steel pipe, pressure fittings, and threaded joints.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division Section "Storm Drainage Piping Specialties."
- C. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- D. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division Section "Common Work Results for Plumbing."
- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division Section "General-Duty Valves for Plumbing."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
 - 1. Install full-port ball valve for piping NPS 2 (DN 50) and smaller.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division Section "Hangers and Supports for Plumbing." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. MSS Type 1, adjustable, steel clevis hangers.
- B. Install supports according to Division Section "Hangers and Supports for Plumbing."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

- 1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
- 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
- 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
- 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
- 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
- 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
- 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
- D. Connect sump pump discharge piping as indicated.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

- 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
- 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 5. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submersible sump pumps.
 - 2. Sump-pump basins and basin covers.
- B. Related Section:
 - 1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Barnes; Crane Pumps & Systems</u>.
 - b. <u>Bell & Gossett Domestic Pump; ITT Corporation</u>.
 - c. Flo Fab inc.
 - d. Glentronics, Inc.
 - e. <u>Goulds Pumps; ITT Corporation</u>.
 - f. Grundfos Pumps Corp.
 - g. <u>Liberty Pumps</u>.
 - h. <u>Little Giant Pump Co.</u>
 - i. McDonald, A. Y. Mfg. Co.
 - j. Pentair Pump Group; Hydromatic Pumps.
 - k. Pentair Pump Group; Myers.
 - 1. Stancor, Inc.
 - m. Sta-Rite Industries, Inc.
 - n. Weil Pump Company, Inc.
 - o. Weinman Division; Crane Pumps & Systems.
 - p. Zoeller Company.
 - 2. Description: Factory-assembled and -tested sump-pump unit.
 - 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 - 4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - 5. Impeller: Statically and dynamically balanced, ASTM A 532/A 532M, abrasion-resistant cast iron and ASTM B 584, cast bronze, design for clear wastewater handling, and keyed and secured to shaft.
 - 6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
 - 7. Seal: Mechanical.
 - 8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: Air or Oil.

9. Controls:

- a. Enclosure: NEMA 250, Type 12.
- b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).

- e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- 10. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

2.2 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 - 1. Material: Cast iron, Fiberglass or Polyethylene.
 - 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
 - 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

- 1. Perform each visual and mechanical inspection.
- 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Pumps and controls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 221623 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Pipes, tubes, and fittings.
- 2. Piping specialties.
- 3. Piping and tubing joining materials.
- 4. Valves.
- 5. Pressure regulators.
- 6. Service meters.
- 7. Concrete bases.

1.3 GAS MAIN CONNECTION

A. Arrange and pay for tap in gas main, of size and in location indicated, by Local Gas Utility Company. Pay all costs pertaining to this work, including materials, labor, piping, excavation, backfill, tap-on fees, meter charges, etc.

1.4 COORDINATION WITH LOCAL GAS UTILITY CO.

A. Coordinate with the Local Gas Utility Co. and determine the extent of the work required to be done by them. Provide the work required by the Contract Documents that the Gas Co. does not provide. If the Gas Co. does not install the gas service piping then furnish the labor and materials necessary to install the gas service pipe. If the Gas Co. does not furnish the gas meter then provide the gas meter in accordance with the Gas Co.'s requirements and the requirements of this section. If the Gas Co. furnishes the gas meter then provide the materials, accessories and labor necessary to install it.

1.5 **DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.6 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
 - 2. Service Regulators: 100 psig (690 kPa) minimum unless otherwise indicated.
 - 3. Minimum Operating Pressure of Service Meter: 5 psig (34.5 kPa).
- B. Natural-Gas System Pressure within Buildings: 0.5 psig (3.45 kPa) or less.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars.
 - 6. Dielectric fittings.
- B. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.
- C. Field quality-control reports.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and service meters to include in emergency, operation, and maintenance manuals.

1.10 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.12 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
 - 1. Notify Owner no fewer than two weeks in advance of proposed interruption of natural-gas service.
 - 2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.13 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in contract documents.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.

- d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
- e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 - 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 - 7. Operating-Pressure Rating: 5 psig (34.5 kPa).
- C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K (ASTM B 88M, Type A).
 - 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 - 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
 - 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch (0.56 mm) thick.
- D. PE Pipe: ASTM D 2513, SDR 11.
 - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.

- 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
- 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
- 4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or flanged or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72 inches (1830 mm.)
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

- 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
- 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
- 3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

- 4. CWP Rating: 125 psig (862 kPa).
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig (862 kPa).
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
 - 6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
 - 1. CWP Rating: 125 psig (862 kPa).
 - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.

- 4. Stem: Bronze; blowout proof.
- 5. Seats: Reinforced TFE; blowout proof.
- 6. Packing: Threaded-body packnut design with adjustable-stem packing.
- 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 8. CWP Rating: 600 psig (4140 kPa).
- 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
- 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
- 2. Body: Bronze, complying with ASTM B 584.
- 3. Plug: Bronze.
- 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 5. Operator: Square head or lug type with tamperproof feature where indicated.
- 6. Pressure Class: 125 psig (862 kPa).
- 7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
- 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. McDonald, A. Y. Mfg. Co.
 - b. Mueller Co.; Gas Products Div.
 - c. Xomox Corporation; a Crane company.
- 2. Body: Cast iron, complying with ASTM A 126, Class B.
- 3. Plug: Bronze or nickel-plated cast iron.
- 4. Seat: Coated with thermoplastic.
- 5. Stem Seal: Compatible with natural gas.
- 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 7. Operator: Square head or lug type with tamperproof feature where indicated.
- 8. Pressure Class: 125 psig (862 kPa).
- 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
- 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Valve Boxes:

- 1. Cast-iron, two-section box.
- 2. Top section with cover with "GAS" lettering.
- 3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
- 4. Adjustable cast-iron extensions of length required for depth of bury.

5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 EARTHQUAKE VALVES

- A. Earthquake Valves: Comply with ASCE 25.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vanguard Valves, Inc.
 - 2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 3. Maximum Operating Pressure: 5 psig (34.5 kPa).
 - 4. Cast-aluminum body with nickel-plated chrome steel internal parts.
 - 5. Nitrile-rubber valve washer.
 - 6. Sight windows for visual indication of valve position.
 - 7. Threaded end connections complying with ASME B1.20.1.
 - 8. Wall mounting bracket with bubble level indicator.

2.6 PRESSURE REGULATORS

- A. General Requirements:
 - 1. Single stage and suitable for natural gas.
 - 2. Steel jacket and corrosion-resistant components.
 - 3. Elevation compensator.
 - 4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.
- B. Service Pressure Regulators: Comply with ANSI Z21.80.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - d. Invensys.
 - e. Richards Industries; Jordan Valve Div.
 - 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 - 6. Orifice: Aluminum; interchangeable.
 - 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 - 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 - 10. Overpressure Protection Device: Factory mounted on pressure regulator.

- 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
- 12. Maximum Inlet Pressure: 100 psig (690 kPa).
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.
 - g. Richards Industries; Jordan Valve Div.
 - 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 - 6. Orifice: Aluminum; interchangeable.
 - 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 - 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 - 10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 - 2. Body and Diaphragm Case: Die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber.
 - 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 - 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

2.7 SERVICE METERS

A. Diaphragm-Type Service Meters: Comply with ANSI B109.2.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Invensys.
- 2. Case: Die-cast aluminum.
- 3. Connections: Steel threads.
- 4. Diaphragm: Synthetic fabric.
- 5. Diaphragm Support Bearings: Self-lubricating.
- 6. Compensation: Continuous temperature.
- 7. Meter Index: Cubic feet and liters.
- 8. Meter Case and Index: Tamper resistant.
- 9. Remote meter reader compatible.
- 10. Maximum Inlet Pressure: 100 psig (690 kPa).
- 11. Pressure Loss: Maximum 0.5-inch wg (124 Pa).
- 12. Accuracy: Maximum plus or minus 1.0 percent.
- B. Rotary-Type Service Meters: Comply with ANSI B109.3.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Meter Company.
 - b. Invensys.
 - 2. Case: Extruded aluminum.
 - 3. Connection: Flange.
 - 4. Impellers: Polished aluminum.
 - 5. Rotor Bearings: Self-lubricating.
 - 6. Compensation: Continuous temperature.
 - 7. Meter Index: Cubic feet and liters.
 - 8. Tamper resistant.
 - 9. Remote meter reader compatible.
 - 10. Maximum Inlet Pressure: 100 psig (690 kPa).
 - 11. Accuracy: Maximum plus or minus 2.0 percent.
- C. Turbine Meters: Comply with ASME MFC-4M.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Meter Company.
 - b. Invensys.
 - 2. Housing: Cast iron or welded steel.
 - 3. Connection Threads or Flanges: Steel.
 - 4. Turbine: Aluminum or plastic.
 - 5. Turbine Bearings: Self-lubricating.
 - 6. Compensation: Continuous temperature.
 - 7. Meter Index: Cubic feet and liters.
 - 8. Tamper resistant.
 - 9. Remote meter reader compatible.

- 10. Maximum Inlet Pressure: 100 psig (690 kPa).
- 11. Accuracy: Maximum plus or minus 2.0 percent.

D. Service-Meter Bars:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Mueller Co.; Gas Products Div.
 - f. Perfection Corporation; a subsidiary of American Meter Company.
- 2. Malleable- or cast-iron frame for supporting service meter.
- 3. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.
- 4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

E. Service-Meter Bypass Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lyall, R. W. & Company, Inc.
 - b. Williamson, T. D., Inc.
- 2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
- 3. Integral ball-check bypass valve.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Pressure Rating: 150 psig (1035 kPa).

c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 150 psig (1035 kPa).
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig (1035 kPa).
- Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

2.9 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements in contract documents for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Install fittings for changes in direction and branch connections.
- E. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in contract documents.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 4. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.

- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in contract documents.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in contract documents.
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in contract documents.
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in contract documents.

3.5 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground, on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in contract documents for pipe bollards.

3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

- 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
- 2. Bevel plain ends of steel pipe.
- 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in contract documents.
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
 - 5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

3.9 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in contract documents for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 PAINTING

- A. Comply with requirements in contract documents for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).
 - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.

- c. Topcoat: Interior latex (semigloss).
- d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Use 3000-psig (20.7-MPa), 28-day, compressive-strength concrete and reinforcement as specified in contract documents.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be the following:
 - 1. PE pipe and fittings joined by heat fusion couplings; service-line risers with tracer wire terminated in an accessible location.
- B. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.

- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

- A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be one of the following:
 - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground:
 - 1. PE valves.
 - 2. NPS 2 (DN 50) and Smaller: Bronze plug valves.
 - 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron, nonlubricated plug valves.

3.18 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, nonlubricated plug valve.

- C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:
 - 1. Two-piece, [full] [regular]-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, nonlubricated plug valve.
- E. Valves in branch piping for single appliance shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.

END OF SECTION 221623

SECTION 223100 - DOMESTIC WATER SOFTENERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Water softeners.
 - 2. Water-testing sets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water softeners.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Salt for Brine Tanks: Furnish in same form as and at least four times original load, but not less than 200 (90.7) lb (kg). Deliver on pallets according to the following:
 - a. Food-Grade Pellet Salt: In 40- or 50- (18.1- or 22.7-) lb (kg) packages.
- 2. Store salt on raised platform where directed by Owner. Do not store in contact with concrete floor.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of water softeners that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of mineral and brine tanks.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - d. Attrition loss of resin exceeding 3 percent per year.
 - e. Mineral washed out of system during service run or backwashing period.
 - f. Effluent turbidity greater and color darker than incoming water.
 - g. Fouling of underdrain system, gravel, and resin with turbidity or by dirt, rust, or scale from water softener or soft water, while operating according to manufacturer's written operating instructions.
 - 2. Water Softeners, Warranty Period: From date of Substantial Completion.
 - a. Mineral Tanks: 10 years.
 - b. Brine Tanks: 10 years.
 - c. Control Valve: One year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 WATER SOFTENERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M
 - 2. Culligan International Company.
 - 3. Watts.

- B. Description: Factory-assembled, pressure-type water softener.
 - 1. Configuration: Single unit with one mineral tank and one brine tank.
 - 2. Mounting: On skids.
 - 3. Wetted Components: Suitable for water temperatures from 40 to at least 120 deg F (5 to at least 49 deg C).
 - 4. Mineral Tanks: FRP, pressure-vessel quality.
 - a. Pressure Rating: 125 (860) psig (kPa) minimum.
 - b. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
 - c. Support Legs or Skirt: Constructed of structural steel, welded to tank.
 - d. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
 - e. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, nonclogging plastic strainers, and arranged for even flow distribution through resin bed.
 - f. Liner: PE, ABS, or other material suitable for potable water.
 - 5. Controls: Fully automatic; 120 V; factory wired and factory mounted on unit.
 - a. Adjustable duration of various regeneration steps.
 - b. Push-button start and complete manual operation.
 - c. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
 - d. Sequence of Operation: Multiport pilot-control valve automatically pressure-actuates main operating valve through steps of regeneration and return to service.
 - e. Pointer on pilot-control valve shall indicate cycle of operation.
 - f. Includes means of manual operation of pilot-control valve if power fails.
 - 6. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:
 - a. Slow opening and closing, nonslam operation.
 - b. Diaphragm guiding on full perimeter from fully open to fully closed.
 - c. Isolated, dissimilar metals within valve.
 - d. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
 - e. Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.
 - f. Sampling cocks for soft water.
 - g. Special tools are not required for service.
 - 7. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressure; does not require field adjustments.
 - a. Meter Control: Each mineral tank is equipped with signal-register-head water meter that produces electrical signal indicating need for regeneration on reaching hand-set total in gallons (liters). Signal will continue until reset.
 - b. Demand-Initiated Control: Single mineral tank is equipped with automatic-reset-head water meter that electrically activates cycle controller to initiate regeneration at preset total in gallons (liters). Head automatically resets to preset total in gallons (liters) for next service run.
 - 8. Brine Tank: Combination measuring and wet-salt storing system.

- a. Tank and Cover Material: Fiberglass, 3/16 inch (4.8 mm) thick; or molded PE, 3/8 inch (9.5 mm) thick.
- b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawal and freshwater refill.
- c. Size: Large enough for at least four regenerations at full salting.

9. Factory-Installed Accessories:

- a. Piping, valves, tubing, and drains.
- b. Sampling cocks.
- c. Main-operating-valve position indicators.
- d. Water meters.

2.3 CHEMICALS

- A. Mineral: High-capacity, sulfonated-polystyrene, ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.
- B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are unacceptable.
 - 1. Form: Processed, food-grade salt pellets.

2.4 WATER-TESTING SETS

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

2.5 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. UL Compliance: Fabricate and label water softeners to comply with UL 979, "Water Treatment Appliances."
- C. Hydrostatically test mineral tanks before shipment to a minimum of one and one-half times the pressure rating.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WATER SOFTENER INSTALLATION

- A. Equipment Mounting:
 - 1. Install water softeners on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in other sections.

- B. Install brine lines and fittings furnished by equipment manufacturer, but not specified to be factory installed.
- C. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
- D. Install water-testing sets mounted on wall, unless otherwise indicated, and near water softeners.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank.
 - 1. Metal general-duty valves are specified in other sections.
 - 2. Exception: Water softeners with factory-installed shutoff valves at locations indicated.
- D. Install pressure gauges on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gauges are specified in other sections.
 - 1. Exception: Water softeners with factory-installed pressure gauges at locations indicated.
- E. Install valved bypass in water piping around water softeners.
 - 1. Metal general-duty valves are specified in other sections.
 - 2. Water piping is specified in other sections.
- F. Install indirect wastes to spill into open drains or pit with drain.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to electrical sections.
- B. Ground equipment according to electrical sections.
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in other sections.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:

- Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks
 exist.
- 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
- 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Water softeners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
- B. Add water to brine tanks and fill with the following form of salt:
 - 1. Water Softeners: Processed, plain salt pellets.
- C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
 - 1. ASTM D 859, "Test Method for Silica in Water."
 - 2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
 - 3. ASTM D 1068, "Test Methods for Iron in Water."
 - 4. ASTM D 1126, "Test Method for Hardness in Water."
 - 5. ASTM D 1129, "Terminology Relating to Water."
 - 6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of water softener Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper water softener operation at rated capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain domestic water softeners.

END OF SECTION 223100

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, direct-vent, gas-fired, storage, domestic-water heater.
 - 2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of commercial, gas-fired, domestic-water heater.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: One year(s).
 - b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Direct-Vent, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Lochinvar, LLC.
 - b. State Industries.
 - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 - 3. Standard: ANSI Z21.10.1/CSA 4.1.
 - 4. Storage-Tank Construction: Steel.

- a. Tappings: ASME B1.20.1 pipe thread.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
- 5. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Burner: For use with direct-vent, gas-fired, domestic-water heaters and natural-gas fuel.
 - h. Ignition: Standing pilot or ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gasignition system.
 - i. Temperature Control: Adjustable thermostat.
 - j. Combination Temperature-and-Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.
- 6. Direct-Vent System: Through-wall, coaxial- or double-channel vent assembly with domestic-water heater manufacturers' outside intake/exhaust screen.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A. O. Smith Corporation.
 - b. AMTROL, Inc.
 - c. <u>State Industries</u>.
 - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 - 3. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - 4. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Comply with requirements for ball- or butterfly-type shutoff valves specified in other sections.

- 1. Comply with requirements for balancing valves specified in other sections.
- F. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.
- G. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.
- H. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- I. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- J. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater minimum of 18 inches (457 mm) above the floor.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in other sections.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 7. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

- 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in other sections.
- C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
 - Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 - 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in other sections.
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in other sections.
- F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in other sections.
- G. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill domestic-water heaters with water.
- I. Charge domestic-water expansion tanks with air to required system pressure.
- J. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in other sections.
- B. Comply with requirements for gas piping specified in other sections.
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks
 exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION 223400

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures:
 - 1. Water closets.
 - 2. Lavatories.
 - 3. Urinals.
 - 4. Sinks.
 - 5. Service Sinks.
 - 6. Wall mounted water fountains.
 - 7. Faucets.
 - 8. Flush Valves.
 - 9. Fixture Supports.
 - 10. Toilet Seats.
 - 11. Fittings, trim and accessories.

1.03 DEFINITIONS

- A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.
- B. Accessory: Device that adds effectiveness, convenience, or improved appearance to a fixture but is not essential to its operation.
- C. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.
- D. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.
- E. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.
- F. Fixture: Installed receptor connected to the water distribution system that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.
- G. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.
- H. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:

- 1. Carrier: Heavy Duty Floor-mounted support for wall-mounted water closet.
- 2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
- I. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.

1.04 SUBMITTALS

A. LEED Submittals:

- 1. Product Data for Prerequisite WE 1 and Credit WE 3, Credit WE 2, and Credit WE 3: Documentation indicating flow and water consumption requirements.
- 2. Product Data for Prerequisite WE 1: Documentation indicating flow and water consumption requirements.
- 3. Product Data for Prerequisite WE 1 and Credit WE 2: Documentation indicating flow and water consumption requirements.
- B. Product Data: Submit product data and installation instructions for each fixture, faucet, specialties, accessories, and trim specified; clearly indicate rated capacities of selected models of water coolers
- C. Color Charts: Submit manufacturer's standard color charts for cabinet finishes and fixture colors.
- D. Maintenance Data: Include data in Maintenance Manual
- E. Quality Control Submittals:
 - 1. Submit certification of compliance with specified ANSI, UL, and ASHRAE Standards.
 - 2. Submit certification of compliance with performance verification requirements specified in this Section.

1.05 QUALITY ASSURANCE

- A. Codes and Standards.
 - 1. ASHRAE Standard 18: "Method of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration Systems.
 - 2. ARI Standard 1010: "Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers.
 - 3. ANSI Standard All7.l: "Specifications for Making Buildings and Facilities Accessible To and Usable by Physically Handicapped People.
 - 4. Public Law 90-480: "Architectural Barriers Act of 1968.
 - 5. UL Standard 399: "Drinking-Water Coolers.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.
- B. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.

1.07 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.
 - 1. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
 - 2. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.

1.08 SEQUENCE OF SCHEDULING:

A. Schedule rough-in installations with the installation of other building components.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Water Closets:

- a. American Standard, Inc.
- b. Briggs Div. Briggs Industries, Inc.
- c. Crane Plumbing/Fiat Products.
- d. Eljer.
- e. Gerber Plumbing Fixture Corp.
- f. Kohler Co.
- g. Zurn Plumbing Products

Urinals:

- a. American Standard America.
- b. Briggs Plumbing Products, Inc.
- c. Ferguson Enterprises, Inc.; ProFlo Brand.
- d. Gerber Plumbing Fixtures LLC.
- e. Kohler Co.
- f. Mansfield Plumbing Products LLC.
- g. Peerless Pottery Sales, Inc.

Lavatories:

- a. American Standard, Inc.
- b. Briggs Div. Briggs Industries, Inc.
- c. Crane Plumbing/Fiat Products.
- d. Eljer, A Household International Co.
- e. Gerber Plumbing Fixture Corp.
- f. Kohler Co.
- g. Zurn Plumbing Products.

Sinks:

- a. American Standard, Inc.
- b. Crane Plumbing/Fiat Products.
- c. Kohler Co.

Shower Enclosures:

- a. American Standard, Inc.
- b. Aqua Bath Company, Inc.
- c. Kohler Co.

Water Fountains:

- a. EBCO Manufacturing Co.
- b. Elkay Manufacturing Co.
- c. Filtrinne Manufacturing Co.
- d. Halsey Taylor, A Household International Co.
- e. Haws Drinking Faucet Co.
- f. Sunroc Corp.
- g. Western Drinking Fountains: Sunroc Corp.

Toilet Seats:

- a. Bemis Mfg. Co.
- b. Beneke Div.: Sanderson Plumbing Products, Inc.
- c. Church Seat Co.
- d. Kohler Co.
- e. Olsonite Corp.
- f. Sperzel Industries, Inc.

Flush Valves:

- a. Cambridge Brass Div.; EMCO Products; Masco Corp.
- b. Coyne & Delaney Co.
- c. Sloan Valve Co.
- d. Toto U.S.A., Inc.
- e. Watrous Flush Valve Co.; Polaris Industries.
- f. Zurn Industries, Inc.; Flush Valve Operations.

Faucets:

- a. American Standard, Inc.
- b. Briggs Div.; Briggs Industries, Inc.
- c. Chicago Faucet Co.
- d. Crane Plumbing/Fiat Products.
- e. Delta Faucet Co.; Div. of Masco Corp.
- f. Eljer; A Household International Co.
- g. Kohler Co.
- h. Moen Group; Stanadyne Corp.
- i. Speakman Co.
- j. Symmons Industries, Inc.
- k. T & S Brass and Bronze Works, Inc.
- 1. Zurn Industries, Inc.; Flush Valve Operations.

Supports:

- a. Ancon, Inc.
- b. Josam Co.
- c. Smith (Jay R.) Mfg. Co.
- d. Wade Div.: Tyler Pipe.
- e. Zurn Industries, Inc.: Hydromechanics Div.

2.02 FIXTURES

1. See drawings for fixture descriptions.

2.03 PLUMBING FIXTURE SUPPORTS

- A. Carriers are specified below by Zurn catalog numbers. Carriers of equal quality, type and supporting capacities will be acceptable, provided they are approved by the State Health Department. Water Closets -- Z-1204-XH4-45. Adjustable coupling shall be cast iron (plastic will not be allowed Install box in same location of supply box being removed Install box in same location of supply box being removed Copy and edit paragraph and subparagraphs in this Article for each type bathtub/shower faucet required.
 - 1. Water Closets -- Z-1204-XH4-45. Adjustable coupling shall be cast iron (plastic will not be allowed).
 - 2. Urinals -- ZR-1221.
 - 3. Lavatories ZR-1231

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design and the referenced standards.
- B. Examine roughing-in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.
- C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 APPLICATION

A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings

3.03 INSTALLATION OF PLUBMING FIXTURES

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design and the referenced standards
- B. Comply with the installation requirements of ANSI All7.1 and Public Law 90-480 with respect to plumbing fixtures for the physically handicapped.
- C. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.
- D. Fasten wall-mounted fittings to reinforcement built into walls.
- E. Fasten counter-mounting-type plumbing fixtures to casework.
- F. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- G. Set shower basins in leveling bed of cement grout.
- H. Install stop valve in an accessible location in each water supply to each fixture.

- I. Install trap on fixture outlet except for fixtures having integral trap.
- J. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- K. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.
- L. Tile Work
- M. Tile work, unless otherwise specified, will be installed under another Division of these Specifications. The Contractor under this Division shall render all reasonable assistance. He shall give correct measurements for cutting, drilling and fitting to and around all measurements for cutting, drilling and fitting to and around all fixtures and piping. If any work is incorrectly cut or drilled through the act or negligence of the Contractor under this Division in not furnishing or in withholding the necessary information after having been requested in writing by these trades to do so, then such damaged work will be replaced with new and properly cut work at the expense of the Contractor under this Division.

3.04 CONNECTIONS

- A. Piping installation requirements are specified in other sections of Division 23. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 23.
 - 2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.05 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.06 ADJUSTING AND CLEANING

- A. Cooperated and coordinate with the commissioning agent in the balancing of the hot water system.
- B. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- C. Adjust water pressure at electric water coolers, and faucets, shower valves, and flush valves, to provide proper flow and stream.
- D. Replace damaged or malfunctioning components of leaking and dripping faucets and stops.
- E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings:

B. Do not allow use of fixtures for temporary facilities, except when approved in writing by the Owner.

END OF SECTION 224000

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pressure water coolers.
 - 2. Bottle filling stations.
 - 3. Supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler and bottle filling station.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers and bottle filling stations to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

- 1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- 2. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

- 3. Comply with UL 399.
- 4. Comply with ASME A112.19.3/CSA B45.4.
- 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
- 7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

2.2 PRESSURE WATER COOLERS

- A. Pressure Water Coolers Surface Wall-Mounted, Powder-Coated Metal: .
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Halsey-Taylor
 - b. Murdock Manufacturing; A Division of Morris Group International.
 - c. <u>Oasis International</u>.
 - 2. Source Limitations: Obtain surface wall-mounted, powder-coated-metal, pressure water coolers from single source from single manufacturer.
 - 3. Type: Vandal resistant.
 - 4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - 5. Control: Push bar.
 - 6. Bottle Filler: Sensor activation.
 - 7. Drain: Grid with NPS 1-1/4 (DN 32) tailpiece.
 - 8. Supply: NPS 3/8 (DN 10) with shutoff valve.
 - 9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
 - 10. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 11. Support: Water-cooler carrier.

2.3 SUPPORTS

- A. Water-Cooler Carrier:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Jay R. Smith Mfg Co; a division of Morris Group International.</u>
 - b. Josam Company.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and bottle filling stations to mounting frames.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in other sections.
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deeppattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in other sections.

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in other sections.
- C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in other sections.
- D. Comply with soil and waste piping requirements specified in other sections.

3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in other sections.
 - 2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.6 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

DIVISION 23 – HVAC

SECTION 230000 - GENERAL PROVISIONS FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

- A. The General Conditions, Special Conditions, Supplemental Conditions, Instructions to Bidders, and other Contract Documents apply to this branch of the work as well as to the other branches.
- B. Provide the materials (piping, ductwork, wiring, conduit, software, equipment, equipment accessories, etc.) and labor necessary for complete and functioning HVAC systems. The Drawings and Specifications are intended to indicate complete working systems. Provide complete and properly working systems, even if all materials and labor necessary to achieve this are not specifically shown on the Drawings or specified.
- C. The Contractor shall familiarize himself with the work of all other trades, general type construction, and the relationship of his work to other sections. He shall examine all working drawings, specifications and conditions affecting his work. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, verify all dimensions in the field and advise the Engineer of any discrepancy before fabricating or performing any work.
- D. The work shall include complete testing of all equipment, piping and ductwork at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment.
- E. Perform any necessary temporary work during construction.
- F. Work under this section shall conform to governing codes, ordinances and regulations of the City, County and State.
- G. The Contractor shall be responsible for any errors in fabrication, for the correct fitting, installation and erection of the various HVAC systems.

1.2 LEED REQUIREMENTS

- A. This project has been designed to achieve the LEED Certified rating, as defined in the LEED 2009 Green Building Rating System.
- B. Comply with requirements as listed in contract documents.

1.3 VIBRATION ISOLATION EQUIPMENT

A. Installation of vibration isolation equipment pertaining to HVAC systems shall be by this Contactor.

1.4 POWDER ACTUATED CONCRETE FASTENERS

A. Obtain written approval from the structural engineer before using powder-actuated concrete fasteners.

B. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

1.5 SUSPENSION FROM METAL DECKING

A. Do not use metal decking for suspension of piping, ductwork or equipment. Hang items from top member of joist or provide additional structure to span between top members if needed.

1.6 COORDINATION BETWEEN TRADES

- A. Demand and examine all Drawings and Specifications pertaining to the construction before installing the work described and shown under these Drawings and Specifications. Cooperate with all other Contractors in locating piping, ductwork, conduit, openings, chases and equipment in order to avoid conflict with any other Contractor's work. Give special attention to points where ducts or piping must cross other ducts or piping and where ducts, piping and conduit must fur into the walls and columns. All work installed above a lay-in ceiling must be coordinated and installed so there is a minimum of 4 inches between the top of the ceiling grid and the bottom of the installation.
- B. Make known to other trades intended positioning of materials and intended order of work. Determine intended position of work of other trades and intended order of installation.

1.7 DISCREPANCIES

A. If any discrepancies occur between the accompanying Drawings and these Specifications and Drawings and Specifications covering other Contracts, report such discrepancies to the Architect/Engineer far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of piping, ductwork, conduit and equipment not installed in accordance with the above instructions, and which interferes with work and equipment of other Contractors.

1.8 EXISTING PIPE AND SERVICES

- A. Existing piping and services are located as accurately as possible from available information, but it shall be the Contractor's responsibility to locate, determine exact elevations and make required connections to such lines and services in manner approved by the Architect/Engineer.
- B. Maintain in operating condition active utilities encountered in the utility installation. Repair to the satisfaction of the Architect/ Engineer and the Owner any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.

1.9 CONTINUOUS OPERATION AND CUTOVER

A. To facilitate the continuous operation of the existing utilities, no utility service shall be tapped into without prior notification of 48 hours to and approval received from the designated authority of the utility company.

1.10 ASBESTOS

A. If during the course of his work the Contractor observes the existence of asbestos, or asbestos-bearing materials, the Contractor shall immediately terminate further work on the project and notify the Owner of the condition. The Owner will, after consultation with the Engineer, determine a further course of action.

1.11 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Extend all grease fittings to an accessible location.

1.12 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.13 HVAC INSTALLATIONS

- A. Coordinate HVAC equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements. Field verify existing conditions and all required measurements before fabricating any piping, ductwork or equipment.
- C. Arrange for chases, slots, and openings in other building components to allow for HVAC installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Coordinate the cutting and patching of building components to accommodate the installation of HVAC equipment and materials.
- G. Where mounting heights are not detailed or dimensioned, install HVAC services and overhead equipment to provide the maximum headroom possible.
- H. Install HVAC equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- I. Coordinate the installation of HVAC materials and equipment above ceilings with suspension system, light fixtures, and other installations.
- J. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- K. Do not install HVAC work where it will interfere with work of other trades.
- L. Do not install HVAC work where it will interfere with access to control panels on HVAC and/or electrical equipment.
- M. Do not install HVAC work where it will interfere with access space around HVAC and electrical equipment. Do not install piping where it will interfere with removal of HVAC coils, filters or fan shafts.

- N. Do not install piping so close to ceiling that ceiling tiles in accessible ceilings cannot be removed without damaging them.
- O. Do not install HVAC work over the top of electrical equipment. Maintain minimum distances away from electrical equipment as required by the Electric Code.

1.14 EXCAVATION, TRENCHING AND BACKFILLING

- A. Photographs: The contractor shall photograph all underground utilities before backfilling. Photographs shall be oriented and labeled so that the locations, all crossings and depths of the utilities can be determined from the photographs.
- B. General: Excavate in accordance with requirements of Division Section "EARTHWORK" and requirements of this Section. Lay the pipe in open trench except when the Architect/Engineer gives written permission for tunneling. Open the trench sufficiently ahead of pipe laying to reveal obstructions. Maintain easy access to fire hydrants by firefighting apparatus. Provide trench crossing as necessary to accommodate public travel.
- C. Provide trench crossing as necessary to accommodate public travel.
- D. Separate Trenches: Unless otherwise shown or requested, provide separate trenches for sewers, water lines and gas lines, respectively, with a minimum of 3' of undisturbed earth between trenches. In locations such as close to building, where separate trenches for sewers and water lines are impracticable, lay the water pipe on a solid shelf at least 18" above the top of the sewer. Always place gas lines in a separate trench from electrical lines.
- E. Width of Trench: Excavate trenches of sufficient width for proper installation of work. When the depth of backfill over sewer pipe exceeds 10', keep the trench at the level of the top of the pipe as narrow as possible.
- F. Sheeting and Bracing: Sheet and brace trenches as necessary to protect workmen and adjacent structures. Comply with local regulations or, in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and prevent injurious caving. When ordered in writing by the Architect/ Engineer, leave sheeting in place and the Contract will be adjusted (See General Conditions): cut off such sheeting not to be removed at least 3' below finished grade.
- G. Water Removal: Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper jointing of pipes. Conduct the discharge from trench dewatering to drains or natural discharge channels.
- H. Disposition of Utilities: Observe rules and regulations governing the respective utilities in executing work under this heading. Protect active utilities from damage or remove in accordance with written instructions of the Architect/Engineer (See General Conditions). Plug, cap or remove inactive and abandoned utilities encountered in trenching operations. In absence of specific requirements, plug or cap such utility line at least 3' from utility line to be installed or as required by local regulations.
- I. Rock Excavation: Materials to be excavated shall include earth and any other material including rock encountered within the limits of trench excavation for the utilities to the depth and extent indicated on the drawings and herein specified. In case of any change ordered by the Owner or Architect/Engineer in the quantity of excavation, the contract price will be adjusted by unit price or as described under Excavation, Filling and Grading of Division Site Work of these specifications. The term "rock" as used is defined to be hard material in nature that cannot be dislodged from its bed and removed therefrom without blasting or drilling. Any other is "earth" insofar as removal of the material to be excavated is concerned.

- 1. Allowance for Additional Rock Excavation: In addition to the rock removal specified in the preceding paragraph, include in the Contract Price an additional ten (10) cubic yards of trench rock removal by mechanical means. If more or less additional rock removal is required due to changes in routing or in elevations of underground utilities authorized in writing, the Contract Price will be adjusted via unit prices.
- J. Blasting: See Division Section "EARTHWORK" to see if blasting is allowed. If blasting is allowed, obtain written approval of method from Architect/Engineer before proceeding with rock excavation.
- K. Trench Bottoms: Lay all pipe, unless otherwise noted or detailed, in undisturbed earth on at least 4" of #9 crushed stone, or other approved grillage. Bedding shall be in place and graded before pipe is installed.
- L. Special Supports: Whenever, in the option of the Architect/Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting sewers or other utilities and appurtenances specified in this section, provide special support as the Architect/Engineer may direct and the Contract Price will be adjusted. (See General Conditions).
- M. Tree Protection: Exercise care to protect the roots of trees to remain. Within the branch spread of such trees, perform trenching by hand. Open the trench only when the utility can be installed immediately; prune injured roots cleanly and backfill as soon as possible. Perform this work under the direction of the Architect/Engineer.
- N. Backfilling: Inspect and test piping and record locations of pipe lines and appurtenances before backfilling.
- O. Trenches Under Floor Slabs: Backfill under floor slab on grade to a point 5'-0" outside of perimeter building wall with fill as specified in Division Section "EARTHWORK". Remove excess excavation materials from the site daily unless otherwise instructed.
- P. Trenches in Other Areas: Backfill with materials in accordance with Division Section "EARTHWORK". Compact backfill thoroughly with a heavy tamper.
- Q. The Contractor, at his option, may backfill the remaining depth of the trench from 12" above top of piping to 12" below finished grade with sand, wash gravel, or fine rock chat. The remaining depth of the trench would then be backfilled as specified in the preceding specification.

1.15 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.

1.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

1.17 WORKING DRAWINGS

- A. Scale of drawings is approximate. Do not scale the drawings to determine locations of mechanical work. Exact locations, dimensions and elevations shall be governed by field conditions. Make field measurements of building before fabricating or installing equipment or materials.
- B. Drawings are based on physical dimensions of one or more manufacturer's equipment. Other approved equipment shall be of such dimensions that it can be readily installed in available space, leaving ample clearance for proper maintenance.
- C. Intent of drawings is to show systems and sizes. Drawings do not necessarily show all required offsets. Work shall be installed to conform with space limitations. Offsets, transitions, fittings, etc., shall be provided as part of the Contract where required to attain this objective.

1.18 EQUIPMENT MOUNTING

- A. Mount equipment with moving parts, such as compressors, fans, air handling units, etc., on vibration supports suitable for the purpose of minimizing noise and vibration transmission unless otherwise specified. In addition, isolate equipment from external connections such as piping, ducts, etc., with flexible connectors, vibration isolators, or other approved means.
- B. Provide each piece of equipment or apparatus suspended from the ceiling or mounted above the floor level with suitable structural support, pipe stand, platform or carrier as approved by the Architect/Engineer.
- C. Gasket and seal to mounting surface flush and surface mounted equipment such as diffusers, grilles, etc.

1.19 PAINTING

- A. Paint the following items.
 - 1. Exposed mechanical piping, valve bodies and fittings bare and insulated, including hangers, platforms, etc.
 - 2. Exposed ductwork, whether or not insulated, and any grilles, diffusers, etc., not factory finished.
 - 3. "Exposed" shall mean exposed to view, such as, in mechanical spaces, tunnels, on roofs and in rooms with no suspended ceilings.
- B. Colors of piping and ductwork shall be as specified in the "Identification for HVAC Piping and Equipment" section of the Specifications. See "color coding" in identification schedules.
- C. Painting shall be done in accordance with the "Painting" section of the specifications unless otherwise specified under other sections of the specifications,
- D. Do not paint aluminum and stainless steel equipment, motor and identification plates, tags, etc.
- E. Do not paint piping and ductwork concealed in walls or above suspended ceilings.

1.20 DEBRIS

A. Remove from the site any debris and dirt caused by the work. Maintain the premises in a clean and orderly condition.

1.21 PROTECTION OF EQUIPMENT AND MATERIALS

A. Provide suitable protection from dampness damage, dirt, etc., for equipment and materials during construction and until final acceptance by the Owner. Keep ends of piping and ductwork capped off when work on them is not in progress. Such protection shall be by a means acceptable to the Architect/Engineer.

1.22 CLEANING UP

A. After completion of the work and before final acceptance of the work, thoroughly clean equipment and materials and remove foreign matter such as grease, dirt, labels, stickers, etc., from the exterior of piping, equipment and associated fabrications.

1.23 EQUIPMENT CONNECTIONS

- A. Make connections to equipment furnished by others whenever such equipment is shown on any part of the drawings or mentioned in any section of the specifications.
- B. Verify equipment locations and the sizes, number, locations, and types of connections to be made before installation of any such equipment.

1.24 EQUIPMENT INSTALLATION INSTRUCTIONS

A. Install HVAC piping, ductwork and equipment in strict accordance with manufacturer's recommendations. Provide equipment accessories necessary for proper operation or recommended by the manufacturer, even if such accessories are not shown on the drawings or mentioned in the specifications.

1.25 PERMITS, CODES AND APPROVALS

- A. Permits. Obtain and pay for the permits and licenses necessary for the complete HVAC systems from the authorities governing such work.
- B. Codes. Installation shall be in accordance with applicable codes and regulations, including but not limited to the following:
 - 1. City or County Building Inspector
 - 2. National and Local Electric Codes
 - 3. Kentucky Building Code and its referenced codes
 - 4. Kentucky Boiler Code
 - 5. Kentucky Energy Code
 - 6. Kentucky State Fire Marshal
 - 7. Local Fire Codes
 - 8. Local Building Inspections
- C. Approvals. All work must be approved by the Architect/Engineer before final payment is made.

1.26 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. When making a shop drawing submittal for materials and/or equipment of a different manufacturer than that specified, it shall be understood and agreed that such substitution if approved will be made without cost to the Owner, regardless of changes in connections, spacing, electrical service, etc.

1.27 WORKMANSHIP

A. Work shall be performed by mechanics skilled in their respective trades and shall present appearance typical of best trade practice. Work not installed in this manner shall be repaired, removed or replaced, or otherwise remedied as directed by the Architect/Engineer.

1.28 RECORD DRAWINGS

A. Keep accurate record of deviations from drawings, particularly where work is concealed. Submit one (1) set of drawings marked to show changes when work is completed.

1.29 SUPERVISION

- A. The Contractor shall personally supervise the work or have a competent superintendent, satisfactory to the Architect/Engineer and Owner on the work at all times during progress with full authority to act.
- B. The Contractor shall lay out his work and be responsible for any necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so. Work at the site of the project shall be observed by the Architect/Engineer or his representative.
- C. Final Inspection: At the time of final inspection of the work performed under this Contract, systems shall be complete in every respect and in perfect operating condition. Surplus materials of every character resulting from work of this section shall have been removed. Sanitary sewers shall be free from sand, silt or other obstructions. Any defect discovered in the utilities subsequent to this inspection shall have been corrected.

1.30 STRUCTURAL RESPONSIBILITY

- A. The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing, or weakening. No structural member shall be cut or otherwise weakened in any manner without the written consent of the Architect/Engineer.
- B. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Owner or Architect/Engineer, without cost to either the Owner or the Architect/ Engineer.

1.31 OPENINGS

- A. This Contractor shall be responsible for the openings he may require in floors, walls, roof or ceilings of any type of new or existing construction whether or not shown on the Architectural, Structural or Mechanical Drawings.
- B. Openings that have been shown on the Architectural and/or Structural Drawings will be provided under other Divisions; however, the responsibility for the correct size and location of such openings shall be that of this Contractor.
- C. Openings that have not been shown on the Architectural and/or Structural Drawings shall be provided by this Contractor.

 Review and conform to all structural requirements as detailed or specified in the Structural drawings and specifications.

1.32 CUTTING, FITTING AND PATCHING

- A. Before doing any cutting or drilling, Contractor shall obtain permission from the Architect/Engineer and shall follow his instructions as to how proposed cutting or drilling is to be done.
- B. Each respective Contractor shall do any cutting, patching, drilling of masonry, steel, wood or iron work and any fitting necessary for the proper installation of apparatus and materials included in these specifications or governed thereby.
- C. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- D. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- E. Coordinate with the Structural Engineer BEFORE drilling, cutting, notching, etc., any new or existing structural members. Obtain written permission from Structural Engineer before doing such work. Locations and sizes of openings and methods of cutting or drilling such openings must be approved in advance by the Structural Engineer. Positively identify exact locations of reinforcing bars or tension cables in structural members by X-raying or other methods approved by the Structural Engineer if required by the Structural Engineer.
- F. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.
- G. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
- H. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
- Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
- J. Comply with requirements of applicable Sections of Division 23 where cutting and patching requires excavating and backfilling.
- K. The patching and finishing shall be done in a workmanlike manner to the satisfaction of the Architect/Engineer.
- L. Patch any openings in existing floors, walls, ceilings or roof, left by removal of existing HVAC work.
- M. Review and conform to all structural requirements as detailed or specified in the Structural drawings and specifications.

1.33 TEMPORARY UTILITIES

A. In any installation that requires deletion of existing services to install new services, a means of providing temporary service for the intermediate period is to be provided. The means of providing temporary service is to be reviewed and revised as required by the Engineer. This means of providing temporary service is to include but not limited to piping and its associated fittings, ductwork and its associated fittings, valves and dampers, insulation, restraints & thrust blocks and all other components required to make a temporary service operational to a level equal to the existing utility service.

1.34 RESTORATION OF SURFACES

A. Each Contractor shall restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, shrubs, and other items damaged or removed by his operations that are outside of the Limit of Site boundaries. Replacement and repairs shall be in accordance with good construction practice and shall match material employed in the original construction of the item to be replaced.

1.35 SHOP DRAWINGS AND OTHER REQUIRED SUBMITTALS

A. Comply with requirements listed in Division 1 Section – SUBMITTAL PROCEDURES and the following paragraphs.

B. Definitions

- 1. Action Submittals: See Division 1 Section "SUBMITTAL PROCEDURES".
- 2. Informational Submittals: See Division 1 Section "SUBMITTAL PROCEDURES".
- C. Prepare and submit to the Architect/Engineer for review, shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc., and any other data required.
- D. Submittal data shall have the stamp of approval of the General Contractor to show that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval will be returned for proper resubmission.
- E. No roughing-in, connections, etc., shall be done until acceptable shop drawings are in the hands of the Contractors. It shall be the responsibility of the Contractor to obtain acceptable shop drawings and to make connections, etc., in the neatest and most workmanlike manner possible.
- F. Submittal data must be complete for each piece of equipment. Partial or incomplete data will not be processed.
- G. Architect/Engineer's review of shop drawings the applies only to general design, arrangement, type, capacity and quality. Such approval does not apply to quantities, dimensions, connection locations, etc. In these cases, the Contractor alone shall be responsible for furnishing the proper quantity of the equipment and/or materials required for seeing that the equipment fits the available space in a satisfactory manner and that piping, electrical and other connections are suitably located.
- H. The Architect's/Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for deviations from drawings or specifications unless he has, in writing, called the Architect's/Engineer's attention to such deviation at the time of submission and secured his written acceptance nor shall it relieve him from responsibility for error in shop drawings or schedules.
- I. Submittal data must be complete and acceptable before project is accepted.

1.36 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Comply with requirements listed in Division 1 Section OPERATION AND MAINTENANCE DATA and the following paragraphs.
- B. This Contractor shall prepare three loose-leaf, bound brochures, entitled "Mechanical Equipment Operation and Maintenance Data." Mark identification on both front and spine of each binder. Each binder shall be a heavy duty 3-ring, vinyl-covered binder with pocket folders for folded sheet information. Each binder cover and spline shall have the project name (as listed on the drawings), what is in the binder (i.e. HVAC ...). If more than one binder is provide the cover and spline shall be marked with "Volume? of?". Binders shall be properly indexed (thumb-tabbed). Information shall be filed under applicable specification section number.
- C. Each brochure shall contain the following information:
 - 1. Name and address of Consulting Engineer, Contractor, and index of equipment, including vendor (name and address).
 - 2. Complete brochures, descriptive data and parts list, etc., on each piece of equipment, including all approved shop drawings.
 - 3. Complete maintenance and operating instructions, prepared by the manufacturer, on each major piece of equipment.
 - 4. Complete shop drawing submittal on temperature controls including control diagrams updated to reflect "as-built" conditions.
 - 5. Final testing and balancing report.
- D. All brochures shall be submitted to the Architect/Engineer or his representative prior to final inspection of the building.

1.37 OWNER INSTRUCTION

- A. Conduct a minimum of a full-day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of mechanical equipment and systems.
- B. Engage factory-authorized service representatives for the following equipment to train Owner's maintenance personnel:
 - 1. Boilers
 - 2. Water chillers
 - 3. Central station air handling units
 - 4. Air terminal units
 - 5. Water treatment systems
 - 6. Fans
 - 7. Pumps
 - 8. Automatic control systems
- C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Review data in the operation and maintenance manuals.
- D. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.
- E. Provide a separate, full-day walk-through seminar for the automatic control systems.

F. Video record the instruction sessions and turn over CD to the Owner. The CD shall be provided to the Owner in "DVD" format.

1.38 LINTELS:

- A. General: Provide lintels for penetration of HVAC systems through masonry walls if not provided elsewhere in these specifications. Lintels shall be type and size required to span the required openings.
- B. Lintels will not be required for openings 16 inches length or less.

1.39 SYSTEM DESIGN WORKING PRESSURES

A. Provide all piping system components (piping, fittings, valves, traps, strainers, etc.) suitable for 125 psig minimum steam working pressure.

1.40 TEMPORARY COOLING

A. Do not provide temporary cooling for areas under construction.

1.41 TEMPORARY DEHUMIDIFICATION

- A. Provide temporary dehumidification for the new construction areas and also for existing areas to be renovated. Maintain a maximum relative humidity of 50%. Provide temporary dehumidification in each area at the time required by construction phasing. Operate temporary dehumidification until all dirt and dust producing activities in the affected area have been completed and area is ready for operation from the permanent HVAC system.
- B. Pay all utilities costs related to operation of temporary dehumidification.
- C. Do not use the permanent building HVAC systems (either new or existing to remain) for temporary dehumidification.

1.42 TEMPORARY HEAT

- A. Provide temporary heat for new construction areas and also for existing areas to be renovated. Maintain a minimum temperature of 55 deg.F. Provide temporary heat in each area at the time required by construction phasing. Operate temporary heat until all dirt and dust producing activities in the affected area have been completed and area is ready for operation from the permanent HVAC system.
- B. Pay all utilities costs related to operation of temporary heating.
- C. Do not use the permanent building HVAC systems (either new or existing to remain) for temporary heating.

1.43 MAINTAINING EXISTING SERVICES

A. Properly make all temporary connections that may be necessary to continue these services in a safe and substantial manner until the permanent services are activated. Upon completion, remove all temporary work, and completely restore all areas that may be affected.

1.44 INTERRUPTION OF EXISTING HVAC SERVICES

- A. In general, do not interrupt HVAC services to occupied areas of the building (both inside and outside construction area). If services must be interrupted (for making temporary connections, for changing over from existing to new, or for making new connections to existing systems, for example) then do such work at the times designated by the Owner.
- B. Schedule this work in advance with the Owner. Perform work on premium time if required to do so by the Owner.
- C. At any time the existing building services are interrupted, the Contractor shall work continuously until the permanent services are restored.

1.45 OWNER OCCUPANCY

A. Full Owner Occupancy: The Owner will occupy the site and buildings surrounding construction area during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work to minimize interference with the Owner's operations. Perform portions of work on premium time if required to do so by the Owner.

1.46 **DEMOLITION**

- A. Disconnect, demolish, and remove existing HVAC systems, equipment, and components indicated to be removed.
- B. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
- C. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
- D. All existing HVAC work (such as piping, ductwork, valves, etc.) shall become the property of the Contractor and shall be removed from the job site.
- E. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- F. Remove or relocate existing HVAC work that interferes with new work of any kind.
- G. The Drawings show existing work to the extent possible. However, all existing work may not be shown. Remove or relocate any existing work that interferes with new work even if it is not shown on the Drawings.
- H. Remove existing work that does not have to remain in service. Relocate existing work that has to remain in service, as required to avoid interference with new work.
- I. Remove or relocate existing electrical work that interferes with new HVAC work, if such work is not indicated to be removed or relocated on the Electrical Drawings. Remove work that does not have to remain in service. Relocate work that has to remain in service, as required to avoid interference with new work.
- J. Existing work serving the floors above or below shall remain in service.

1.47 PROVIDING AIRTIGHT SPACES

- A. In rooms where room walls extend above ceiling to the floor or roof above, caulk around all new and existing penetrations through walls, ceilings, floors and/or roofs to make completely airtight rooms. Seal penetrations both above and below suspended ceilings. Seal any openings left by removal of any existing or new work. Caulking used shall be the same type as specified in the Architectural Specifications.
- B. Patch around rough openings of penetrations to form a tight fit before caulking.

1.48 LICENSE REQUIRED

A. Contractors installing HVAC work must be licensed by the Kentucky Board of Heating, Cooling and Ventilation Contractors. Submit proof of licensing.

1.49 PROFESSIONAL ENGINEER QUALIFICATIONS

A. When the term "professional engineer", or "qualified professional engineer" is used anywhere in these specifications it shall mean a person who is licensed to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 FIRESTOPPING

- A. Provide seals for any opening through any walls, floors, or ceilings used as passage for mechanical components such as piping or ductwork.
- B. General: Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings as established by testing identical assemblies per ASTM E 814 by Underwriters' Laboratories, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction. Sealant shall provide protection equal or exceeding the fire resistance rating of fire rated walls, partitions, ceilings or floors. Use two-part or one part sealants as required to meet required fire resistance ratings.
- C. Foamed-In-Place Fire-Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around cables, conduit, pipes and similar penetrations through walls and floors.
- D. One-Part Fire-Stopping Sealant: One part elastomeric sealant formulated for use in a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors.
- E. Intumescent Fire-Stopping Sealant: A one-part, acrylic sealant that expands when exposed to heat.
- F. Firestop Compound: Trowelable compound for large openings
- G. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - 1. Foamed-in-Place Fire-Stopping Sealant:

- a. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
- b. "Pensil 851": General Electric Co.
- 2. One-Part Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
 - b. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
 - c. "RTV 7403"; General Electric Co.
 - d. "Fyre Putty"; Standard Oil Engineered Materials Co.
 - e. "FS 601"; Hilti Inc.
 - f. "FS 611A"; Intumescent Sealant; Hilti Inc.
 - g. "FS 635"; Hilti Inc.
- H. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials to fill openings around mechanical and electrical services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

2.2 ACCESS UNITS

- A. General. The work of this article is limited to the provisions for access through other work for access to HVAC work, and does not include internal access provisions (within the HVAC work). In general and where possible, furnish or furnish-and-mount required access units in other trades' work prior to their work, so that cutting and patching for the subsequent installation of such access units will not be required. In occupied spaces, provide finished access units of the maximum concealment type, including locks where appropriate, and matching access units provided in the same expanse of finish (for non-HVAC access, if any).
- B. The scope of access units to be furnished or provided as HVAC work includes those units indicated on the mechanical drawings or specified in Division 23 sections, and those additional units required for adequate access to HVAC work and not shown or specified individually.
- C. Access Doors. Standard welded-steel construction, 16-gage frames and 14 gage door panels, 175 degree concealed spring hinges, rust-inhibitive prime coat, flush cam lock (for screw-driver operation where keyed lock is not required), recessed to receive applied finish where applicable (such as in concealed spline ceilings).
- D. Removable Access Plates. Where only hand access is sufficient, provide removable plate-type access unit, or minimum size which will facilitate the required access. Provide units of the type, style, design, material and finish appropriate for the location and exposure in each instance. In exposed surfaces of occupied spaces provide round plate units, flush floor units and frameless low-profile wall units, primed-for-paint in painted surfaces and polished chrome or stainless steel finish in other surfaces.
- E. Access Thru Fire Rated Walls or Ceilings. Where access doors or plates are required in fire rated partitions or ceilings, provide U.L. listed "B" Label doors or plates rated for 1-1/2 hours. Furnish doors with automatic closers and key operated latches that latch automatically when door closes.

2.3 FLASHING:

A. General: Provide flashings from the following listing for each penetration of HVAC systems through roofs or waterproof membranes. Select appropriate flashing method for the type of roof used. Flashing shall be in accordance with roofing manufacturer's recommendations.

- B. Copper Flashing: Provide cold-rolled sheet copper, complying with ANSI/ASTM B 370, weighing 16 oz. per sq. ft. (0.0216" thick), except as otherwise indicated.
- C. Lead Flashing: Provide sheet lead complying with FS QQ-L-2201, Grade B; formed from common desilverized pig lead, complying with ANSI/ASTM B 29; weighing 4.0 lbs. per sq. ft., except as otherwise indicated.
- D. Bituminous Coating: FS TT-C-494, or MIL-C-18480, or SSPC-paint 12, cold-applied solvent-type bituminous mastic coating for application in dry film thickness of 15 mils per coat.
- E. Laminated Sheet Flashing: Bottom laminate of heavy-duty nonplasticized chlorinated polyethylene (CPE) synthetic elastomer, with top laminate of built-up roofing (BUR) sheet material; weighing 8 oz. per sq. ft.
- F. Manufacturer's Recommendations: Except as otherwise shown or specified, comply with recommendations and instructions of manufacturer of sheet metal being installed.
- G. Coat back side of lead flashings where in contact with concrete and other cementitious substrates, by painting surface in area of contact with heavy application of bituminous coating, or by other permanent separation as recommended by manufacturer of metal.
- H. On vertical surfaces, lap flashings minimum of 3".
- I. On vertical surfaces, for slopes of not less than 6" in 12", lap unsealed flashings minimum of 6".
- J. For embedment of metal flashing flanges in roofing or composition flashing or stripping, extend flanges minimum of 6" for embedment.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in contract documents.
- B. Concrete Base reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
- C. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-

in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.3 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230000

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.

- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Motors used with VFD's shall be provided with AEGISTM SGR shaft grounding rings or equal. On motors greater than 100HP also provide an insulated, insulated ceramic or hybrid bearing on the non-drive end of the motor.
 - 5. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 6. Motors shall be totally enclosed, inverter-duty motors. Inverter-ready and inverter-rated motors are not acceptable.
 - 7. Motors shall be the premium efficiency design of the motor manufacturer.
 - 8. Motors shall not be limited to use with the same manufacturer's variable frequency drives.
 - 9. Motors shall be designed with critical vibration frequencies outside operating range of controller output.
 - 10. Motors shall comply with all of NEMA MG1, Part 31 "Definite Purpose Inverter-fed Motors." Motor Frames shall be cast iron construction.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

- 1. Permanent-split capacitor.
- 2. Split phase.
- 3. Capacitor start, inductor run.
- 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
- Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

- 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in contract documents.

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in contract documents.
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in contract documents.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves.
 - 2. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

- a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
- 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.
- 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Filled-system thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
- B. Related Sections:
 - 1. Section 231123 "Facility Natural-Gas Piping" for gas meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FILLED-SYSTEM THERMOMETERS

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.

- c. Trerice, H. O. Co.
- 2. Standard: ASME B40.200.
- 3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
- 4. Element: Bourdon tube or other type of pressure element.
- 5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
- 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
- 7. Pointer: Dark-colored metal.
- 8. Window: Glass.
- 9. Ring: Stainless steel.
- 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
- 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
- 12. Accuracy: Plus or minus 1 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
 - 8. Bore: Diameter required to match thermometer bulb or stem.
 - 9. Insertion Length: Length required to match thermometer bulb or stem.
 - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Ashcroft Inc.
- b. Marsh Bellofram.
- c. Trerice, H. O. Co.
- d. Weiss Instruments, Inc.
- 2. Standard: ASME B40.100.
- 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Ring: Stainless steel.
- 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads.

2.6 HYDRONIC INDICATOR SYSTEM (REQUIRED AT EACH PUMP):

- A. Hydronic indicator shall meet ASA Grade AA specifications for pressure gauges, accurate to 1/2 of 1% and shall clearly so state on the dial. Case shall be 4-1/2" diameter, stem mounted, heavy steel with screwed ring and unbreakable crystal. Movement shall be of stainless to monel with recalibrator, compound scale calibrated both in pounds and feet from full vacuum to selected pressure, twin tip pointer for accurate reading, and quick-set dial for pressure comparison. Maximum indicator pressure shall at least equal pump shut-off head plus fill system pressure and shall exceed this minimum by no more than 50 psi.
- B. Manifold valve shall be spring return pushbutton manifold of brass construction with ports for connection to system at indicated points and with test port connection for gauge calibration.
- C. Provide master test gauge with standard test hose for calibration test.

2.7 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Flow Design, Inc.
 - 2. Trerice, H. O. Co.
 - 3. Watts; a Watts Water Technologies company.
 - 4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

- D. Thread Size: NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.8 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Trerice, H. O. Co.
 - 2. Watts; a Watts Water Technologies company.
 - 3. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

- H. Install valve and snubber in piping for each pressure gage for fluids.
- I. Install test plugs in piping tees.
- J. Install permanent indicators on walls or brackets in accessible and readable positions.
- K. Install connection fittings in accessible locations for attachment to portable indicators.
- L. Install Hydronic Indicator System with manifold valves at each pump. Connect each port on the manifold to each measuring point as detailed on the Drawings.
- M. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler.
 - 3. Inlets and outlets of each chiller.
 - 4. Inlet and outlet of each hydronic coil in air-handling units.
 - 5. Outside-, return-, supply-, and mixed-air ducts.
- N. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water connection.
 - 3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic zone shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- C. Thermometers at inlets and outlets of each chiller shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- E. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be the following:

- 1. Direct-mounted, metal-case, vapor-actuated type.
- F. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).
- B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C).
- C. Scale Range for Air Ducts: 0 to 150 deg F (Minus 20 to plus 70 deg C).

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each chiller chilled-water connection shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each pump shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 psi (0 to 600 kPa).
- B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi (0 to 600 kPa).

END OF SECTION 230519

SECTION 230523.11 - GLOBE VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Bronze globe valves.
 - 3. Iron globe valves.
 - 4. Chainwheels.

1.3 **DEFINITIONS**

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle and globe valves closed to prevent rattling.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B16.18 for solder joint.
 - 5. ASME B31.1 for power piping valves.
 - 6. ASME B31.9 for building services piping valves.
- C. Refer to HVAC valve schedule articles for applications of valves.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions.

2.2 BRONZE ANGLE VALVES

- A. Class 150 Bronze Angle Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. KITZ Corporation.
 - b. Stockham; Crane Energy Flow Solutions.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron[, bronze, or aluminum].

2.3 BRONZE GLOBE VALVES

- A. Class 125 Bronze Globe Valves:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

- b. <u>Crane Fluid Systems; Crane Co.</u>
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. <u>NIBCO INC</u>.
- f. <u>Powell Valves</u>.
- g. Watts.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron.

B. Class 150 Bronze Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.4 IRON GLOBE VALVES

A. Class 125 Iron Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.

2. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.

- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.
- g. Operator: Handwheel or chainwheel.

2.5 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
 - 1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
 - 2. Chain: Hot-dip-galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Do not install iron or steel valves in copper piping systems. Use bronze valves.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above center of pipe.

- F. Install valves in position to allow full stem movement.
- G. Install chainwheels on operators for globe valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
- H. Install valve tags. Comply with requirements in contract documents for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Throttling Service: Globe or angle valves.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valveend option is indicated in valve schedules.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller: Bronze angle or globe valves, Class 150, bronze disc, with threaded ends.
- B. Pipe NPS 2-1/2 (DN 65) and Larger: Iron globe valves, Class 125 with flanged ends.

3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller: Bronze angle or globe valves, Class 150, bronze disc, with threaded ends.
- B. Pipe NPS 2-1/2 (DN 65) and Larger: Iron globe valves, Class 125 with flanged ends.

END OF SECTION 230523.11

SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Steel ball valves.
 - 4. Iron ball valves.

1.3 **DEFINITIONS**

- A. CWP: Cold working pressure.
- B. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for solder-joint connections.
 - 6. ASME B31.1 for power piping valves.
 - 7. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Refer to HVAC valve schedule articles for applications of valves.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
 - 2. Handlever: For quarter-turn valves smaller than NPS 3 (DN 80).
- H. Valves in Insulated Piping:
 - 1. Include 2-inch (50-mm) stem extensions.
 - 2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.
- I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

- A. Two-Piece Brass Ball Valves with Full Port and Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts; a Watts Water Technologies company.
 - 2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- B. Two-Piece Brass Ball Valves with Full Port and Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

- A. Two-Piece Bronze Ball Valves with Full Port and Bronze or Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE.
 - h. Stem: Bronze.

- i. Ball: Chrome-plated brass.
- j. Port: Full.
- B. Two-Piece Bronze Ball Valves with Full Port and Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.4 STEEL BALL VALVES

- A. Class 150 Steel Ball Valves with Full Port and Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Conbraco Industries, Inc.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 285 psig (1964 kPa).
 - c. Body Design: Split body.
 - d. Body Material: Carbon steel, ASTM A 216, Type WCB.
 - e. Ends: Flanged.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.

2.5 IRON BALL VALVES

- A. Class 125 Iron Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.
- c. KITZ Corporation.
- d. Watts; a Watts Water Technologies company.

2. Description:

- Standard: MSS SP-72.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Do not install iron or steel valves in copper piping systems. Use bronze valves.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- E. Examine threads on valve and mating pipe for form and cleanliness.
- F. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- G. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valveend option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller: Two piece, full port, brass or bronze with stainless-steel trim.
- B. Pipe NPS 2-1/2 (DN 65) and Larger: Iron ball valves.
 - 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - 2. Steel Ball Valves: Class 150.
- C. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron ball valves.
 - a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - 2. Class 150 steel ball valves.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller: Two piece, full port, brass or bronze with stainless-steel trim.
 - 1. Valves may be provided with solder-joint ends instead of threaded ends.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron ball valves.
 - a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Class 150 steel ball valves.

END OF SECTION 230523.12

SECTION 230523.13 - BUTTERFLY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Iron, single-flange butterfly valves.
 - 2. High-performance butterfly valves.
 - 3. Chainwheels.

1.3 **DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B16.5 for pipe flanges and flanged fittings, NPS 1/2 through NPS 24.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.1 for power piping valves.
 - 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Types:
 - 1. Gear Actuator: For valves NPS 4 (DN 100) and larger.
 - 2. Handlever: For valves NPS 3 (DN 80) and smaller.
 - 3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Valve Installation" Article.
- G. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions with extended necks.

2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. DeZURIK.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.3 HIGH-PERFORMANCE BUTTERFLY VALVES

- A. Class 150, Single-Flange, High-Performance Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. DeZURIK.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.

2. Description:

- a. Standard: MSS SP-68.
- b. CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
- e. Seat: Reinforced PTFE or metal.
- f. Stem: Stainless steel; offset from seat plane.
- g. Disc: Carbon steel.
- h. Service: Bidirectional.

2.4 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.
 - 1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
 - 2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Do not install copper or bronze valves, or valves with copper or bronze parts, in high temperature hot water systems. Use only steel valves.
- C. Do not install valves with threaded ends in high temperature hot water systems. Use only welded or flanged ends.
- D. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- E. Locate valves for easy access and provide separate support where necessary.
- F. Install valves in horizontal piping with stem at or above center of pipe.
- G. Install valves in position to allow full stem movement.
- H. Install chainwheels on operators for butterfly valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
- I. Install valve tags. Comply with requirements in contract documents for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM seat, aluminum-bronze disc.
 - 2. High-Performance Butterfly Valves: Class 150, single flange.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM seat, aluminum-bronze disc.
 - 2. High-Performance Butterfly Valves: Class 150, single flange.

END OF SECTION 230523.13

SECTION 230523.14 - CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze swing check valves.
 - 2. Bronze, center-guided check valves.
 - 3. Iron swing check valves.
 - 4. Iron swing check valves with closure control.
 - 5. Iron, center-guided check valves.
 - 6. Iron, plate-type check valves.

1.3 **DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B16.18 for solder joint.
 - 5. ASME B31.1 for power piping valves.
 - 6. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.3 BRONZE, CENTER-GUIDED CHECK VALVES

- A. Non Slam (Silent) Check Valves 2-inches and Smaller:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mueller Steam Specialty; a division of SPX Corporation.
 - b. Metraflex, Inc.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80.
 - b. CWP Rating: 250 psig (1725 kPa).
 - c. Spring: Copper or Stainless Steel
 - d. Body Design: Horizontal or Vertical Flow.
 - e. Body Material: ASTM B-145-5A, ASTM B62 or ASTM B 584, bronze.
 - f. Ends: Threaded.
 - g. Disc: NBR, PTFE, or TFE.

2.4 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.5 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. NIBCO INC.
 - 2. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
- c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos free.
- i. Closure Control: Factory-installed, exterior lever and spring.

2.6 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Style: Compact wafer.
 - f. Seat: Bronze.

2.7 IRON, PLATE-TYPE CHECK VALVES

- A. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane; Crane Energy Flow Solutions.
 - c. Mueller Steam Specialty.
 - d. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: API 594.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).
 - c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).
 - d. Body Design: Wafer, spring-loaded plates.
 - e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - f. Seat: Bronze.
- B. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Flo Fab inc.
 - b. Sure Flow Equipment Inc.

2. Description:

- a. Standard: API 594.
- b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
- c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
- d. Body Design: Wafer, spring-loaded plate.
- e. Body Material: ASTM A 126, gray iron.
- f. Seat: EPDM or NBR.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Do not install iron or steel valves in copper piping systems. Use bronze valves.
- C. Do not install copper or bronze valves, or valves with copper or bronze parts, in high temperature hot water systems. Use only steel valves.
- D. Do not install valves with threaded ends in high temperature hot water systems. Use only welded or flanged ends.
- E. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- F. Locate valves for easy access and provide separate support where necessary.
- G. Install valves in horizontal piping with stem at or above center of pipe.

- H. Install valves in position to allow full stem movement.
- I. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- J. Install valve tags. Comply with requirements for valve tags and schedules in contract documents.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze center-guided, silent type check valves.
 - b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valveend option is indicated in valve schedules.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 CHILLED-WATER WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Swing Check Valves: Class 150, bronze disc.
 - 3. Bronze, center-guided, silent type check valves.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

- 2. Iron Swing Check Valves: Class 125, metal seats.
- 3. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring.
- 4. Iron, Center-Guided Check Valves: Class 150, compact-wafer, metal seat.
- 5. Iron, Plate-Type Check Valves: Class 125 single plate; resilient seat.
- 6. Iron, Plate-Type Check Valves: Class 150 dual plate; metal seat.
- 7. Iron, Plate-Type Check Valves: Class 150 dual plate; resilient seat.

3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Swing Check Valves: Class 150, bronze disc.
 - 3. Bronze, center-guided, silent type check valves.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - 2. Iron Swing Check Valves: Class 125, metal seats.
 - 3. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring.
 - 4. Iron, Center-Guided Check Valves: Class 150, compact-wafer, metal seat.
 - 5. Iron, Plate-Type Check Valves: Class 125 single plate; resilient seat.
 - 6. Iron, Plate-Type Check Valves: Class 150 dual plate; metal seat.
 - 7. Iron, Plate-Type Check Valves: Class 150 dual plate; resilient seat.

END OF SECTION 230523.14

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.
- 4. Thermal-hanger shield inserts.
- 5. Fastener systems.
- 6. Pipe stands.
- 7. Equipment supports.

B. Related Sections:

- 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- 2. Section 230548 "Vibration Controls for HVAC" for vibration isolation devices.
- 3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 **DEFINITIONS**

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 **QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

- 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
- 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. Flex-Strut Inc.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
 - e. Unistrut; Part of Atkore International.
 - f. Wesanco, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
 - 7. Metallic Coating: Electroplated zinc.
- B. Non-MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
 - 7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

- A. Powder Actuated Concrete Fasteners
 - 1. Obtain written approval from the structural engineer before using powder-actuated concrete fasteners
 - 2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- B. Suspension From Metal Decking
 - 1. Do not use metal decking for suspension of piping, ductwork or equipment. Hang items from top member of joist or provide additional structure to span between top members if needed.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm)
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

- 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
- 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
- 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

- 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
- 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230533 - HEAT TRACING FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes heat tracing for HVAC piping with the following electric heating cables:
 - 1. Self-regulating, parallel resistance.
- B. Electrical wiring for all controls, signal devices, alarms, etc., shall be in accordance with diagrams and instructions from the supplier of the medical gas systems. All wiring, conduit and wiring connections required for the complete installation shall be part of the work by the Contractor under this Division. All work shall be installed in accordance with Division 16 specification requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BriskHeat.
 - 2. Chromalox.
 - 3. Delta-Therm Corporation.
 - 4. Easy Heat; a division of EGS Electrical Group LLC.
 - 5. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 - 6. Raychem; a brand of Tyco Thermal Controls LLC.
 - 7. Thermon Americas Inc.
 - 8. Trasor Corp.
- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel No. 16 AWG, tinned, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.
- F. Maximum Operating Temperature (Power On): 150 deg F (65 deg C).
- G. Maximum Exposure Temperature (Power Off): 185 deg F (85 deg C).
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg F (minus 1 to plus 10 deg C).
- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to other sections of contract documents.
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written instructions; use slack cable to allow movement without damage to cable.
- B. Make connection to power distribution panel as required. Coordinate with Division 26 Electrical Contractor for locations of power distribution panels and available circuits for use by this system.
- C. Install electric heating cables after piping has been tested and before insulation is installed.
- D. Install electric heating cables according to IEEE 515.1.
- E. Install insulation over piping with electric cables according to Section 23 0719 "HVAC Piping Insulation."
- F. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- G. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 2. Test cables for electrical continuity and insulation integrity before energizing.
 - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.

END OF SECTION 230533

SECTION 230548 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Elastomeric isolation pads.
- 2. Elastomeric isolation mounts.
- 3. Restrained elastomeric isolation mounts.
- 4. Open-spring isolators.
- 5. Housed-spring isolators.
- 6. Restrained-spring isolators.
- 7. Housed-restrained-spring isolators.
- 8. Pipe-riser resilient supports.
- 9. Resilient pipe guides.
- 10. Air-spring isolators.
- 11. Restrained-air-spring isolators.
- 12. Elastomeric hangers.
- 13. Spring hangers.
- 14. Mechanical anchor bolts.
- 15. Adhesive anchor bolts.
- 16. Vibration isolation equipment bases.
- 17. Restrained isolation roof-curb rails.

B. Related Requirements:

- 1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
- 2. Section 220548 "Vibration Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

A. IBC: International Building Code.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device required.

a. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings:

- 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation device.
 - 1. Include design calculations and details for selecting vibration isolators and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and wind forces required to select vibration isolators and wind restraints and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.
 - 4. Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure. Indicate association with vibration isolation devices.
 - c. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer and testing agency.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Applicable Standards:
 - 1. The Kentucky Building Code.

- 2. International Building Code.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Pad Material: Oil and water resistant with elastomeric properties.
 - 5. Surface Pattern: Waffle pattern.
 - 6. Infused nonwoven cotton or synthetic fibers.
 - 7. Load-bearing metal plates adhered to pads.
 - 8. Sandwich-Core Material: Resilient and elastomeric .
 - a. Surface Pattern: Waffle pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.

- g. Vibration Isolation.
- h. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

- a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
- b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
- 3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

- A. Restrained Elastomeric Isolation Mounts: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

- 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
- 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure
 - 6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top housing with attachment and leveling bolt.

2.6 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.

- 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top plate with threaded mounting holes.
 - c. Internal leveling bolt that acts as blocking during installation.
- 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
- 4. Precompressed: Where specified, hanger shall be precompressed and locked at the rated deflection by means of a resilient upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30 degree capability.
- 5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 - 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 THRUST LIMITS

- A. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig (3.45 MPa)on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Mountings & Controls, Inc.
 - 2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
 - 2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.14 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.

- 3. Mason Industries, Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.15 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. California Dynamics Corporation.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries, Inc.
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation.
 - 6. Vibration Mountings & Controls, Inc.
- B. Steel Rails: Factory-fabricated, welded, structural-steel rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

- 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.16 HOUSEKEEPING PADS

- A. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
- B. Housekeeping pad anchors shall consist of a ductile iron casting that is tapered and hexagonal, smaller at its base than at its top. The upper portion shall have holes for rebars to pass through. The anchor shall be continuously threaded from top to bottom for the attachment of soleplates. Housekeeping pad anchors shall be attached to the structural slab using stud wedge anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static loads within specified loading limits.

3.3 VIBRATION CONTROL INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in contract documents.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

- E. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:

- 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
- 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
- 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
- 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 EQUIPMENT BASES

- A. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.
 - 1. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - Obtain Architect's approval before transmitting test loads to structure. Provide temporary loadspreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. Test and adjust restrained-air-spring isolator controls and safeties.

- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in contract documents.

3.8 FIELD INSTRUCTION AND SUPERVISION:

- A. Manufacturer shall provide trained field supervision to insure proper installation and performance.
- B. Visit the project site before installation is begun and instruct installers in correct installation procedures for vibration isolation.
- C. Observe installation of other work related to vibration isolation work, including concrete pad installation; and, after completion of other related work (but before equipment startup), shall furnish written report to Contractor and Engineer listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover the following:
 - 1. Equipment installations (performed as work of other sections) on vibration isolators.
 - 2. Piping connections including flexible connections.
 - 3. Ductwork connections including provisions for flexible connections.
 - 4. Passage of piping and ductwork which is to be isolated through walls and floors.
 - 5. Installation of isolators on duct and piping systems.
- D. Do not start-up equipment until inadequacies have been corrected in manner acceptable to Vibration Isolator Manufacturer.

3.9 DEFLECTION MEASUREMENTS

1. Upon completion of vibration isolation work, prepare report showing measured equipment deflections for each major item of equipment as indicated.

3.10 VIBRATION ISOLATOR SCHEDULE

- A. Isolator type and deflection shall be according to schedules in contract documents.
- B. General: Except as otherwise indicated, apply the following types of vibration isolators at indicated locations or for indicated items of equipment. Selection is Installer's option where more than one type is indicated.

- C. Pad-Type Isolators or Elastomeric Mounts: Install where the following equipment is indicated in noncritical locations:
 - 1. Package boilers.
 - 2. Close-couple pumps, of less than 7½ H.P..
 - 3. Floor mounted air handling units.
 - 4. Vent sets.
 - 5. Utility sets.
 - 6. Sound traps in ductwork.
- D. Spring Isolators: Install where the following floor-mounted equipment is indicated:
 - 1. Package boilers, in critical locations.
- E. Equipment Rails and Spring Isolators: Install where the following floor-mounted equipment is indicated:
 - 1. Air-handling-units, 7-1/2 H.P. and larger.
 - 2. Utility sets.
 - 3. Vent sets.
 - 4. Axial flow fans, 7-1/2 H.P. and larger.
 - 5. Centrifugal fans, 7-1/2 H.P. and larger.
- F. Fabricated Equipment Base and Spring Isolators: Install where the following equipment is indicated:
 - 1. Centrifugal fans.
 - 2. Reciprocating air compressor, in noncritical locations.
 - 3. Reciprocating refrigeration compressor, in noncritical locations.
 - 4. Close-coupled pumps, in critical locations.
 - 5. Utility sets, in critical locations.
 - 6. Vent sets, in critical locations.
 - 7. Air handling units, in critical locations.
 - 8. Centrifugal fans not exceeding 20 H.P., in critical locations.
- G. Inertia Base Frame and Spring Isolators: Install where the following equipment is indicated:
 - 1. Close-coupled pumps, of less than 7-1/2 H.P., in critical locations.
 - 2. Close-coupled pumps, 10 H.P. and larger.
 - 3. Base-mounted pumps.
 - 4. Centrifugal fans, 20 H.P. and larger, in critical locations.
 - 5. Reciprocating air compressors.
 - 6. Reciprocating refrigeration compressors.
 - 7. Internal combustion engines.
 - 8. Engine driven equipment.
- H. Isolation Hangers: Install where the following suspended equipment is indicated:
 - 1. Package air-handling-units.
 - 2. Utility sets.
 - 3. Vent sets.
 - 4. Axial fans.
 - 5. Centrifugal fans.
- I. Isolate duct as follows:
 - 1. Provide spring and neoprene hanger or floor spring mount on all duct discharge runs for a distance of 50' from the connected equipment. Spring deflection shall be a minimum of 0.75".

- 2. Provide precompressed spring and neoprene hanger or floor spring mount on all duct runs having air velocity of [1000 fpm] [3000 fpm] or more. Spring deflection shall be a minimum of 0.75".
- 3. Provide precompressed spring and neoprene hanger or floor spring mount on sound traps in ductwork.
- J. Isolate piping as follows:
 - 1. Horizontal pipe isolation: The first three pipe hangers in the main lines near the mechanical equipment shall be precompressed spring and neoprene type. Floor supported piping shall rest on spring type isolators. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces the first three hangers shall have 3/4" deflection for pipe sizes up to and including 3", 11/2" deflection for pipe sizes up to and including 6", and 21/2" deflection thereafter.
 - 2. Riser isolation: Risers shall be suspended from spring and neoprene hangers or supported by floor spring isolators, all-directional acoustic pipe anchor, and pipe guide. Steel springs shall be a minimum of 0.75" except in those expansion locations where additional deflection is required to limit load changes to ±25% of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.
- K. Riser Isolators: Install where the following risers pass through floors and roofs; provide support-type where riser support is required:
 - 1. Pipe risers.
 - a. Pipe risers, within 50'-0" of connection with vibration- isolation-mounted equipment.
 - 2. Pipe risers, in critical locations.
 - a. Pipe risers, 2" pipe size and larger, in critical locations.
 - 3. Ductwork risers, in critical locations.
 - a. Ductwork risers, where air velocity is 3000 fpm or greater.
 - b. Ductwork risers, within 50'-0" of connection with vibration- isolation-mounted equipment.
 - 4. Flexible Duct Connectors: Install at the following ductwork connections:
 - a. Connections with vibration-isolation-mounted air handling equipment.
 - b. Connections with fixed wall louvers for air intake and exhausts.
 - c. Where ductwork, 1.0 sq. ft. and greater, changes directions in critical locations.
 - 5. Flexible Pipe Connectors: Install in piping systems at the following locations:
 - a. Connections, 3/4" pipe size and larger, with vibration- isolation-mounted equipment.

END OF SECTION 23 0548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Equipment labels.
- 2. Warning signs and labels.
- 3. Pipe labels.
- 4. Duct labels.
- 5. Underground-Type Plastic Line Marker.
- 6. Utility Service Markers
- 7. Ceiling Identification Discs
- 8. Stencils.
- 9. Valve tags.
- 10. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.

- b. Brimar Industries, Inc.
- c. Seton Identification Products.
- 2. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
- 3. Letter Color: Black.
- 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- 5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- 6. Fasteners: Stainless-steel rivets or self-tapping screws.
- 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Seton Identification Products.
- 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- 3. Letter Color: White.
- 4. Background Color: Black.
- 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- 7. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- 8. Fasteners: Stainless-steel rivets or self-tapping screws.
- 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.

- 3. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1. Brady Corporation.
- 2. Brimar Industries, Inc.
- 3. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) Insert dimension thick, and having predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Black.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 UNDERGROUND-TYPE PLASTIC LINE MARKERS:

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
- B. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.6 UTILITY SERVICE MARKERS:

- A. Markers shall consist of bronze plates, ground and polished, and marked to identify the service. Markers shall also be stamped with arrows indicating the direction the service extends. A typical marker detail is shown on the Drawings.
- B. Markers locating services at the building shall be installed in masonry or concrete walls 2' above grade. Markers locating services elsewhere on the site shall be installed in concrete walks or curbs, or in 6" x 6" steel reinforced concrete posts as detailed.

2.7 MARKERS FOR IDENTIFYING EQUIPMENT ABOVE CEILINGS:

A. Provide manufacturer's standard laminated plastic, color-coded equipment markers for identifying type and location of mechanical equipment above suspended ceilings. Provide markers with pressure adhesive and engraved as scheduled in this section. Markers shall be narrow enough to fit on exposed ceiling grid and long enough to accommodate specified engraving. Install on ceiling grid closest to equipment above ceiling.

2.8 STENCILS

A. Stencils for Piping:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brimar Industries, Inc.
 - b. Carlton Industries, LP.
 - c. Champion America.
- 2. Lettering Size: Size letters according to ASME A13.1 for piping.
- 3. Stencil Material: Fiberboard or metal.
- 4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
- 5. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Ducts:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brimar Industries, Inc.
 - b. Carlton Industries, LP.
 - c. Champion America.
- 2. Lettering Size: Minimum letter height of 1-1/4 inches (32 mm) for viewing distances up to 15 feet (4-1/2 m) and proportionately larger lettering for greater viewing distances.
- 3. Stencil Material: Fiberboard or metal.
- 4. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
- 5. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.
- C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brimar Industries, Inc.
 - b. Carlton Industries, LP.
 - c. Champion America.
 - 2. Lettering Size: Minimum letter height of 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.
 - 3. Stencil Material: Fiberboard or metal.
 - 4. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.

5. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.

2.9 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Seton Identification Products.
- B. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass S-hook.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.10 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Seton Identification Products.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 MECHANICAL EQUIPMENT IDENTIFICATION ABOVE CEILING:

A. Attach Seton-Ply Discs to ceiling grid under equipment or to access doors in non-accessible ceilings as follows:

| | | | Background | Lettering |
|----|-------------------|----------|------------|-----------|
| 1. | Equipment | Engraved | Color | Color |
| 2. | Valve | V | Yellow | Black |
| 3. | Fire Damper | FD | Black | White |
| 4. | Smoke Damper | SMD | Black | White |
| 5. | Volume Damper | VD | Black | White |
| 6. | Air Terminal Unit | VAV | Red | White |
| 7. | Heating Coil | HC | Blue | White |

B. Isolating valves serving equipment above ceiling (such as heating coils, fan coil units, etc.) do not require identification discs.

3.5 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in contract documents.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.

- 5. Near major equipment items and other points of origination and termination.
- 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
- 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- 8. Space every 10' in mechanical rooms.
- D. Provide piping identification markers in accordance with the following schedule. Provide black lettering on yellow backgrounds and white lettering on backgrounds with other colors.

3.6 COMMONWEALTH OF KENTUCKY (STATE). STANDARD COLOR CODING FOR HVAC PIPING

A. Piping Identification Schedule

| | | Background | Letter | |
|-----|------------------------|------------|--------|---------------|
| | Piping | Color | Color | Legend - Band |
| 1. | Relief Valve Discharge | Orange | Black | R.V.D. |
| 2. | Blowdown | Orange | Black | B.D. |
| 3. | Hot Water Supply | Orange | Black | H.W.S. |
| 4. | Hot Water Return | Orange | Black | H.W.R. |
| 5. | Chilled Water Supply | Green | White | C.W.S. |
| 6. | Chilled Water Return | Green | White | C.W.R. |
| 7. | Condensate Drainage | Green | White | C.D. |
| 8. | Refrigerant Suction | Yellow | Black | R.S. |
| 9. | Refrigerant Hot Gas | Yellow | Black | R.H.G. |
| 10. | Refrigerant Liquid | Yellow | Black | R.L. |

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.7 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

| | Duct System | Stencil Wording |
|----|-------------|-----------------|
| 1. | Primary Air | "Primary Air" |
| 2. | Supply Air | "Supply Air" |
| 3. | Return Air | "Return Air" |
| 4. | Outside Air | "Outside Air" |
| 5 | Exhaust Air | "Exhaust" |

3.8 UNDERGROUND PIPING IDENTIFICATION:

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 12" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.9 UTILITY SERVICE MARKERS

A. Install utility service markers where shown on plans for underground utilities and at building entrance or exit or any change in direction.

3.10 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
- C. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.
- D. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Chilled Water: 1-1/2 inches (38 mm), round.
 - b. Refrigerant: 1-1/2 inches (38 mm), round.
 - c. Hot Water: 1-1/2 inches (38 mm), round.
 - d. Gas: 1-1/2 inches (38 mm), round.

2. Valve-Tag Colors:

- a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
- b. Flammable Fluids: Black letters on a safety-yellow background.
- c. Combustible Fluids: White letters on a safety-brown background.
- d. Potable and Other Water: White letters on a safety-green background.
- e. Compressed Air: White letters on a safety-blue background.
- f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.11 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All Division 23 specification sections, drawings, and general provisions of the contract apply to work of this section, as do other documents referred to in this section.

1.2 SCOPE OF WORK

- A. The owner will directly contract with a certified testing, adjusting, and balancing (TAB Agency) to test, adjust, and balance the HVAC systems.
- B. This specification section is included herein to assist and inform the Contractor of the standards, requirements and scope of the work to be performed by the Commonwealth's TAB Contractor.

1.3 PREPARATION AND COORDINATION REQUIREMENTS – GENERAL

- A. Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work shall be provided to the TAB Agency no later than 30 days prior to the start of TAB work.
- B. System installation and equipment startup shall be complete prior to the TAB Agency's being notified to begin.
- C. The building control system shall be complete and operational. The Building Control system contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.
- D. All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.
- E. Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

1.4 PREPARATION AND COORDINATION REQUIREMENTS – HVAC CONTROLS

- A. Written notice shall be submitted through the General Contractor to the Architect stating that the Control System is operating and controlling the HVAC System.
- B. The control subcontractor shall have entered all data needed for the TAB Agency to begin work.
- C. The Control subcontractor shall be available to correct any problems that the TAB Agency might have with the systems.
- D. All costs for additional work by the TAB Agency due to the Contractor's failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for HVAC controls.

1.5 PREPARATION AND COORDINATION REQUIREMENTS - MECHANICAL

- A. Written notice shall be submitted through the General Contractor to the Architect stating that the HVAC system is operational and ready for the TAB Agency.
- B. The Mechanical subcontractor shall have proved all units operational and all air outlets in the full open position.
- C. The Mechanical Contractor shall be available to correct any problems that the TAB Agency might have with any equipment or systems.
- D. The Mechanical Contractor shall furnish and install any replacement sheaves, pulleys and drive belts required for flow adjustments, as determined by the TAB Agency. Adjustable sheaves shall be selected so that the final adjustment position is in the middle third of the total adjustment range.
- E. All costs for additional work by the TAB Agency due to the Contractor's failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for mechanical work.

1.6 PREPARATION AND COORDINATION REQUIREMENTS – DUCTWORK

- A. Ductwork air leakage testing shall be performed by the TAB Agency.
- B. The ductwork/sheetmetal subcontractor shall promptly correct any related problems discovered by the leakage tests.
- C. All costs associated with retesting and/or delays or other problems which impede the TAB Agency from performing such testing shall be paid by the contractor and any subcontractor(s) for ductwork.

1.7 WORK BY TAB AGENCY

- A. The work included in the remainder of this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results. This work shall be performed by the TAB Agency under direct contract to the owner. The remainder herein is also for the information of the Contractor and all subcontractors.
- B. The items requiring testing, adjusting, and balancing include the following:
 - 1. AIR SYSTEMS:
 - a. Supply Fan AHU
 - 2. RETURN FANS
 - a. Exhaust Fans
 - b. Zone branch and main ducts
 - c. Diffusers, Registers and Grilles
 - d. Coils (Air Temperatures)
 - 3. HYDRONIC SYSTEMS:
 - a. Pumps
 - b. System Mains and Branches
 - c. Chillers
 - d. Boilers
 - e. Coils

1.8 QUALIFICATIONS

- A. Agency qualifications: The TAB Agency shall be a current member of a nationally recognized balance organization ("National Organization"). The TAB Agency is to have no association to the installation of any mechanical work including but not limited to ducts, controls, and piping. The TAB Agency is to have no association with any manufacturer of any equipment that is installed including but not limited to controls, pumps, fans, boiler and chillers. This Organization shall provide the owner with National Guarantee document certifying the work of the TAB Agency. Acceptable organizations are Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB).
 - 1. The selected TAB Agency must provide proof of certification for the total project (air, water, sound, vibration, etc.).
 - 2. The selected TAB Agency shall possess computers, cables, and software needed to operate the building control system. This requires the TAB Agency to be properly licensed and/or trained to run the Control contractor's software.

1.9 DEFINITIONS, REFERENCES AND STANDARDS

A. All work shall be in accordance with the latest edition of the National Standards, as published by the National Organization affiliated with the TAB Agency.

1.10 SUBMITTALS

- A. Qualifications: The TAB Agency shall submit a company resume listing personnel and project experience in air and hydronic system balancing and a copy of the agency's test and balance engineer (TBE) certificate. Certification in noise, vibration, and air quality shall be submitted as the job requires.
- B. Procedures and agenda: The TAB Agency shall submit the TAB procedures and agenda proposed to be used.

1.11 REPORTS

- A. Final TAB Report The TAB Agency shall submit the final TAB report for review by the engineer. All outlets, devices, HVAC equipment, etc., shall be identified, along with a numbering system corresponding to report unit identification. The TAB Agency shall submit an "National Project Performance Guaranty" assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and National Standards.
 - 1. Submit 3 copies of the Final TAB Report.

1.12 DEFICIENCIES

- A. Any deficiencies in the installation or performance of a system or component observed by the TAB Agency shall be brought to the attention of the appropriate responsible person. Also notify the mechanical project representative from the Division of Engineering.
- B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.

PART 2 - INSTRUMENTATION

A. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of the National Standards.

PART 3 - EXECUTION

3.1 GENERAL

- A. The specific systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with national Standards. Adjustment tolerances shall be + or 10% unless otherwise stated.
- B. Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be marked to show final settings.
- C. All information necessary to complete a proper TAB project and report shall be per National Organization's standards unless otherwise noted. The descriptions for work required, as listed in this section, are guides to the minimum information needed.

3.2 AIR SYSTEMS

- A. The TAB Agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. The TAB Agency shall perform the following TAB procedures in accordance with the National Standards:
 - 1. For supply fans:
 - Fan speeds Test and adjust fan RPM to achieve maximum or design CFM. Confirm proper rotation direction.
 - b. Current and Voltage Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse Perform a Pitot-tube traverse of main supply and return ducts, as applicable to obtain total CFM.
 - d. Outside Air Test and adjust the outside air on applicable equipment using a Pitot-tube traverse. If a traverse is not practical use the mixed-air temperature method if the inside and outside temperature difference is at least 20 degrees Fahrenheit or use the difference between Pitot-tube traverses of the supply and return air ducts.
 - e. Static Pressure Test and record system static profile of each supply fan.
 - 2. For exhaust fans:
 - a. Fan speeds Test and adjust fan RPM to achieve maximum and design CFM. Confirm proper rotation direction.
 - b. Current and Voltage Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
 - c. Pitot-tube Traverse Perform a Pitot-tube traverse of main exhaust ducts to obtain total CFM.
 - 3. For zone, branch and main ducts:
 - a. Adjust ducts to within design CFM requirements. As applicable, at least one zone balancing damper shall be completely open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
 - 4. For diffusers, registers and grilles:

- a. Tolerances Test, adjust, and balance each diffuser, grille, and register to within 10% of design requirements. Minimize drafts.
- b. Identification Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.

5. For coils:

a. Air Temperature – Once air flows are set to acceptable limits, take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.

3.3 HYDRONIC SYSTEMS

A. The TAB Agency shall, as applicable, confirm that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; and that all balancing valves (except bypass valves) are set full open. The TAB Agency shall perform the following testing and balancing functions in accordance with the National Standards:

1. For pumps:

- a. Test and adjust chilled water, hot water, and condenser water pumps to achieve maximum or design GPM. Check pumps for proper operation. Confirm proper rotation direction. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-Off/Dead head calculations.
- b. Current and Voltage Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.
- 2. For system mains and branches:
 - a. Adjust water flow in pipes to achieve maximum or design GPM.

3. For chillers:

- a. Verify that chillers have been started by others and are in operation. Test and adjust chiller water flows to achieve maximum or design GPM.
- b. Current and Voltage Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
- c. Test and record temperature profiles of chillers.

4. For boilers:

- a. Verify that boilers have been filled and started by others, and are in operation.
- b. Current and Voltage As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
- c. Test and adjust water flow through water boilers.
- d. Test and record temperature and pressure profiles of water or steam boilers.

5. For coils:

- a. Tolerances Test, adjust, and balance all chilled-water and hot-water coils within 10% of design requirements.
- b. Verification Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.

3.4 ADDITIONAL TAB SERVICES

A. Preconstruction Plan Check and Review:

1. The TAB Agency shall review the project documents and contractor submittals for their effect on the TAB process and overall performance of the HVAC system. It shall submit recommendations for enhancements or changes to the system within 30 days of document review.

B. Job Site Inspections:

1. During construction, the TAB Agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Inspections shall be conducted a minimum of two times. (Typically, these are performed when 60% of the total system is installed and again when 90% of the total system is installed, prior to insulation of the duct and piping). The TAB Agency shall submit a written report of each inspection.

C. Kitchen Hood Testing:

1. The TAB Agency shall test and adjust kitchen hood total airflow by duct Pitot-tube traverse or best possible method, if applicable under local code. All sealing of test holes in the exhaust duct to be by others per local code requirements. The TAB Agency shall test and record face velocities in accordance with design requirements. It shall test and adjust makeup airflow (if included) to meet design face velocities and pressurization and to minimize turbulence.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed warewash exhaust.
 - 4. Indoor, exposed warewash exhaust.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor, concealed supply and return.
 - 8. Outdoor, exposed supply and return.

B. Related Requirements:

1. Division 01 Section "Summary" for funding grant restrictions and the "Buy American" Contractor Verification form.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
- Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating
 that products comply with the testing and product requirements of the California Department of
 Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various
 Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Contractor Verification Form: Notarized Contractor Verification form to document compliance with the "Buy American" provisions defined in Division 01 Section "Summary."
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.

- b. Fibrex Insulations Inc.; FBX.
- c. Johns Manville: 800 Series Spin-Glas.
- d. Knauf Insulation; Insulation Board.
- e. Manson Insulation Inc.; AK Board.
- f. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges Marathon Industries; 225.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 - 4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
 - 5. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges Marathon Industries; 405.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-
 - d. Mon-Eco Industries, Inc.; 44-05.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 5. Color: Aluminum.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.

- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
- 5. Color: White.
- 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches (75 mm).
 - 3. Thickness: 11.5 mils (0.29 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches (75 mm).
 - 3. Thickness: 6.5 mils (0.16 mm).
 - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
- 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches (50 mm).
 - 3. Thickness: 3.7 mils (0.093 mm).
 - 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.8 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. For ducts mounted on trapeze hangers or channel supports, provide rigid foam type insulation inserts at hanger contact points to prevent crushing of insulation.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- C. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
 - 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
 - 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
- b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
- c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
- d. Do not overcompress insulation during installation.
- e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

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3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed oven and warewash exhaust.
 - 4. Indoor, exposed oven and warewash exhaust.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor, concealed supply and return.
 - 8. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

3.11

- A. Concealed supply-, -exhaust-outside-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
- B. Exposed, supply-, -exhaust-outside-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
- C. Exposed, outside-air plenum insulation shall be one of the following:

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1. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Exposed mineral-fiber insulation in any room and all mineral-fiber insulation in boiler, mechanical rooms, and tunnels shall have an 8 ounce canvas jacket applied over the factory jacketing to further protect the insulation from abuse. This jacketing must be properly applied with lagging adhesive, such that the outer surface is smooth and free or wrinkles. The canvas jacketing in all mechanical areas is to be prepared for painting, and then painted according to the University of Kentucky standard piping color coding.

END OF SECTION 230713

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SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Calcium silicate.
 - b. Cellular glass.
 - c. Mineral fiber.
 - d. Mineral Wool.
 - e. Phenolic.
 - f. Polyisocyanurate.
 - g. Polyolefin.
 - h. Polystyrene.
 - i. Manufactured Thermal Reusable Insulation Blankets:
 - 2. Fire-rated insulation systems.
 - 3. Insulating cements.
 - 4. Adhesives.
 - 5. Mastics.
 - 6. Lagging adhesives.
 - 7. Sealants.
 - 8. Factory-applied jackets.
 - 9. Field-applied fabric-reinforcing mesh.
 - 10. Field-applied cloths.
 - 11. Field-applied jackets.
 - 12. Tapes.
 - 13. Securements.
 - 14. Corner angles.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.

- 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
- 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
- 6. Detail application of field-applied jackets.
- 7. Detail application at linkages of control devices.
- 8. Detail field application for each equipment type.
- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control reports.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (The); Thermo-12 Gold.
- 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
- 2. Block Insulation: ASTM C 552, Type I.
- 3. Special-Shaped Insulation: ASTM C 552, Type III.
- 4. Board Insulation: ASTM C 552, Type IV.
- 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
- 6. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
- 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- J. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- 3. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- L. Mineral Wool, Preformed and Precision Cut Pipe Insulation: Felted mineral wool bonded with a high temperature binder. Nominal density is 7 lb/cu. ft. Service temperature up to 1200 deg F (649 deg C) and water repellent. Thermal conductivity (k-value) at 200 deg F (55 deg C) is 0.30 Btu x in./h x sq. ft. x deg F (0.044 W/m x K) or less. Provide ASJ/SSL jacket. Pipe insulation shall meet ASTM C 547 and ASTM C 585. Factory applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Rock Wool Manufacturing Company.
- M. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apache Products Company; ISO-25.
 - b. Dow Chemical Company (The); Trymer.
 - c. Duna USA Inc.; Corafoam.
 - d. Elliott Company; Elfoam.
 - 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
 - 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
 - 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Pipe Applications: ASJ-SSL.
 - b. Equipment Applications: ASJ-SSL.
- N. Manufactured Thermal Reusable Insulation Blankets:

- 1. Blankets shall be designed for use with a minimum of 500°F surface temperatures. Outer jacket shall be 34 oz/sq.yd. silicone impregnated fiberglass cloth. Inner jacket shall be 17.7 oz/sf.yd. plain fiberglass fabric covered with a stainless steel type 304 knitted wire mesh 0.011" dia. @ 16 sf/lb. Blanket shall have 2" fiberglass type "E", 11 lb/c.f. insulation to achieve a surface temperature of 120°F at 70°F ambient temperature.
- 2. Blanket Construction shall be a sewn lock stitch with a minimum of 7 stitches per inch. All raw jacket edges will have a folded silicone fiberglass cloth binding. No raw cut jacket edge will be exposed. Stitching will be done with a stainless steel thread.
- 3. Blanket will overlap mating flanges as well as pipe insulation with a minimum of 2" overlap. Where blanket cannot overlap insulation, blanket will butt up to insulation with a friction closing seam. Open gaps are not acceptable.
- 4. To accommodate a leak and detect its origin, blanket pieces will either have a low point drain grommet or the design will incorporate a mating seam at the low point.
- 5. Stainless steel quilting pins will be placed at random locations no greater than 18" apart to maintain uniform thickness and prevent shifting of the insulation filler.
- 6. Blanket will be fastened using hook and loop velcro straps. Fasteners shall be no more than 8" apart.
- 7. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Firwin
 - b. LIT Industries, Inc.
 - c. M.I.T. International, Inc.
 - d. Shannon Enterprises of W. N.Y.,Inc.
 - e. Valley Acoustical & Thermal Services, Inc.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-97.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
 - c. Marathon Industries, Inc.; 290.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
- C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
- 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
- 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
- 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
 - 3. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
 - 4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

- 1. Joint Sealants for Cellular-Glass, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.: 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Permanently flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
- 5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
- 5. Color: Aluminum.

2.7 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products, Division of ITW; Metal Jacketing Systems.
- b. PABCO Metals Corporation; Surefit.
- c. RPR Products, Inc.; Insul-Mate.
- 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

- A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches (50 mm).
 - 3. Thickness: 3.7 mils (0.093 mm).
 - 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.

- 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with closed seal.
- 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with closed seal.

B. Insulation Pins and Hangers:

- 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
- 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

2.11 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- B. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

- 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
- 2. Verify that surfaces to be insulated are clean and dry.
- 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.

- 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
- 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
 - 1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.

- 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
- 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
- 7. Stagger joints between insulation layers at least 3 inches (75 mm).
- 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
- 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
- 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

- 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
- 6. Use thermal reusable insulation blankets to insulate strainers, steam traps, steam expansion joints, steam pressure reducing valves and steam back pressure regulating valves.
- 7. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
- 8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- 9. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- 10. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges except divide the twopart section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
 - 6. Use thermal reusable insulation blankets to insulate steam strainers, steam control valves, steam traps, steam expansion joints, and steam pressure reducing valves.

3.7 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
- 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
- 3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

- 1. Install preformed pipe insulation to outer diameter of pipe flange.
- 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
- 4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

- 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
- 2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
- 3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

- 1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 2. Install insulation to flanges as specified for flange insulation application.
- 3. Finish valve and specialty insulation same as pipe insulation.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
- 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
- 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
- 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

- 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
- 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

- 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
- 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

- 1. Install preformed sections of cellular-glass insulation to valve body.
- Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 3. Install insulation to flanges as specified for flange insulation application.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
- 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
- 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
- 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

- 1. Install preformed pipe insulation to outer diameter of pipe flange.
- 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
- 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

- 1. Install preformed sections of same material as straight segments of pipe insulation when available.
- 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 4. Install insulation to flanges as specified for flange insulation application.

3.10 POLYISOCYANURATE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 - 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 - 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of polyisocyanurate insulation to valve body.
 - Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.12 FINISHES

- A. Equipment, and Pipe Insulation with Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Fire-suppression piping.
 - 2. Drainage piping located in crawl spaces.
 - 3. Below-grade piping.
 - 4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water, 40 Deg F (5 Deg C) and above:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Insulation shall be any of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.
 - b. Polyisocyanurate: 1 inch (25 mm) thick.
 - 2. NPS 2 (DN 50) and Larger: Insulation shall be any of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches (50 mm) thick.
 - b. Polyisocyanurate: 1-1/2 inches (38 mm) thick.
- B. Condensate Piping, below 40 Deg F (5 Deg C):
 - 1. NPS 1-1/2 (DN 40) and Smaller: Insulation shall be any of the following:

- a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.
- b. Polyisocyanurate: 1 inch (25 mm) thick.
- C. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and below:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.
 - 2. NPS 2 (DN 50) and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inch (50 mm) thick.
- D. Low Pressure Steam and Condensate 15 psig and 237 Deg F (114 Deg C) and Lower]:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch (37 mm) thick.
 - 2. NPS 2 (DN 50) and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 3 inch (75 mm) thick.
- E. Medium and High Pressure Steam and Steam Condensate, 100 psig and 350 Deg F (177 Deg C) and below:
 - 1. NPS 3/4 (DN 20) and Smaller: Insulation shall be any of the following:
 - a. Calcium Silicate: 2 inches (50 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: 2 inches (50 mm) thick.
 - 2. NPS 1 (DN 25) and Larger: Insulation shall be any of the following:
 - a. Calcium Silicate: 3 inches (75 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: 3 inches (75 mm) thick.
- F. High Pressure Steam and Steam Condensate, above 350 Deg F (177 Deg C) and High Temperature-Hot-Water Supply and Return:
 - 1. NPS 3/4 (DN 20) and Smaller: Insulation shall be any of the following:
 - a. Calcium Silicate: 3 inches (75 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: 2 inches (50 mm) thick.
 - 2. NPS 1 (DN 25) and Larger: Insulation shall be any of the following:
 - a. Calcium Silicate: 3 inches (75 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: 3 inches (75 mm) thick.
- G. Hot Service Vents:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

- H. Steam to Water Converters:
 - 1. Insulation shall be one of the following:
 - a. Mineral-Fiber, Board, 2 inches (50 mm) thick and 3-lbs/cu.ft. (48-kg/cu.m) nominal density.
- I. Heating-hot -water air separator:
 - 1. Insulation shall be one of the following:
 - a. Mineral-Fiber, Pipe and Tank, 2 inches (50 mm) thick.
- J. Steam flash tank:
 - 1. Insulation shall be one of the following:
 - a. Mineral-Fiber, Pipe and Tank, 2 inches (50 mm) thick.
- K. Chilled water pump:
 - 1. Insulation shall be one of the following:
 - a. Polyisocyanurate, 1-1/2 inches (38 mm) thick.
- L. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches (38 mm) thick.
 - b. Flexible Elastomeric: 1 inch (25 mm) thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - d. Phenolic: 1 inch (25 mm) thick.
 - e. Polyolefin: 1 inch (25 mm) thick.
- M. Engine Exhaust Piping and Silencer, All Pipe Sizes: Calcium silicate, 4 inches (100 mm) thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

Exposed piping in any room and all piping in boiler, mechanical rooms, and tunnels shall have an 8 ounce canvas jacket applied over the fiberglass factory ASJ/SSL jacketing to further protect the insulation from abuse. This jacketing must be properly applied with lagging adhesive, such that the outer surface is smooth and free or wrinkles. The canvas jacketing in all mechanical areas is to be prepared for painting, and then painted according to the University of Kentucky standard piping color coding. All chilled water piping insulation shall be completely sealed so that a perfect vapor barrier is achieved.

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Emergency Generator Exhaust, Piping:

1. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.

END OF SECTION 230719

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements, Division 1 Specification Sections apply to the work specified in this section.

1.2 **DEFINITIONS**

- A. Building automation system.
- B. DDC: Direct digital control.
- C. I/O: Input/output.
- D. Interlock: When the term "interlock" is used in the control sequence, it shall mean a hardware interlock. Software interlocks are not acceptable.
- E. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- F. MS/TP: Master slave/token passing.
- G. PC: Personal computer.
- H. PID: Proportional plus integral plus derivative.
- I. RTD: Resistance temperature detector.

1.3 DESCRIPTION OF WORK:

A. General:

- 1. See "KCTCS Building Automation Systems Implementation Guide for Tridium Niagara Web Supervisor Integration" attached to end of this section. Guide is intended to serve as a guide for controls suppliers and service providers in the installation of the new KCTCS building automation features for existing facilities and new construction projects.
- 2. KCTCS is standardizing their Building Automation System network. KCTCS will be owner furnishing a portion of the controls system and integration, but not all.
 - a. Successful contractor shall assist the owner in completing KCTCS JACE ORDER INFORMATION SHEET.

B. KCTCS Building Automation System Description

1. A typical controls system architecture in the existing KCTCS inventory is comprised of multiple tiers of communication; the most fundamental being the local equipment controller (BAS Level 1) at the bottom rung, up to the JACE network controller (BAS Level 2) which manages the multiple

equipment controllers and passes information up to the server level (BAS Level 3) which manages the human interface and reporting functions. It is a KCTCS requirement that the BAS Architecture implementation and any expansion be accomplished with open protocol / open distribution components and programming, with all programming intellectual property being non-proprietary, including all software keys with full disclosure. This has been difficult to accomplish due to the complexity and proprietary nature of the many control suppliers that have been utilized at the 16 colleges and headquarters facilities.

- a. BAS Level 2 Field Cabinets (BAS Network Controllers) shall be an open protocol/open distribution controller.
- 2. In order to take full advantage of the existing BAS investment and avoid adding to the BAS complexity, the Niagara AX Framework is the software platform being used to implement the KCTCS BAS network. The intent is to accommodate the existing BAS networks; yet, maintain the ability to competitively bid construction projects without compromising the BAS standards and operations. The open nature of the Niagara AX Framework software platform will enable this plan.
- 3. To enable competitive bidding of construction projects, without compromising the BAS standards and operations, KCTCS will furnish Tridium Vykon JACE network controllers (BAS Level 2) to the Controls Provider as OFCI devices. Level 1 Application Specific and Custom Application Controllers and control sensing, actuation and similar devices are intended to be provided by the Control Supplier through the competitive bid process, subject to paragraph 6 below; Building Automation System / Control Product Requirements and applicable provisions of these Agency Requirements.
 - In lieu of owner furnished Vykon JACE, vendor may furnish Automated Logic BACnet/IP router.
 - b. In addition, owner will provide graphics packages to controls contractor. Controls contractors will map their points into these graphics packages.
- 4. The Enterprise BAS Architecture must also be implemented in a manner that will maintain the integrity and security of BAS and other KCTC System networks. These provisions are detailed within KCTCS reference documentation. This is a living document, being updated as technology and security developments occur; the design team should request the most current version at the concept development stage of a project.
- 5. The control system communications shall be transparent, meaning that the user or control programmer does not need to know the details of system architecture and operation.
- 6. The project design shall provide for all labor, materials, equipment programming, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC), electronic sensing and actuation devices, and Graphical User Interface (GUI) with color graphic displays available to the Enterprise network user.
- 7. The Controls System Local Area Network (CLAN) for dedicated controllers shall be at least 100 Mpbs Ethernet furnished by the control system supplier and shall support BACnet IP, BACnet MSTP, Lon, Modbus TCP, and Modbus Async for maximum flexibility for integration of building data with Universal Network Controllers (UNCs) to control system supplier's Application Specific Controllers, Custom Application Controllers and control devices.
- 8. The Enterprise Ethernet (IEEE 802.3) shall utilize the WAN furnished and maintained by KCTCS.
- 9. The control system shall consist of an open architecture with capability to utilize EIA standard 709.1 (LonTalkTM) protocol, as a common communication protocol between controllers and integral ANSI / ASHRAETM Standard 135-2XXX (BACnet-current release) functionality to assure interoperability between all system components. Both the Lon protocol and the BACnet protocol are required to assure that the project is fully supported by the two leading HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs. Where specific products are not Lon or BACnet compatible, the Modbus protocol is an acceptable communication protocol to that specific device only.

- 10. Where necessary or desired, Lon packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.
 - a. Any such encapsulation of the Lon protocol into IP datagrams shall conform to existing Lon guide-lines for such encapsulation and shall be based on industry standard protocols.
- 11. The products used in constructing the control system shall be LonMarkTM compliant. In instances where LonMarkTM devices are not available; the controls system supplier shall provide LonWorksTM devices with application source code, device resource files, and external interface definitions.
- 12. The software tools including cables and connectors required to manage Lon, Modbus and BACnet protocols must be provided with the system. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP.
- 13. All work described in this section shall be installed, circuit tested, and calibrated by factory certified technicians qualified for this work and in the regular employment of the Control System Supplier.
- 14. Provide Portable Engineering Station (PES) software, and interfaces to provide uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all Lon Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. PES connectivity shall be via digital wall sensor connected to controller.
- C. Furnish and install and fit-up in complete working order, with all accessories required, the automatic temperature control and monitoring systems shown on the Drawings and specified herein. The systems shall be properly connected, piped and wired in a manner conforming to the laws, ordinances and codes now in force in the Commonwealth of Kentucky.
 - 1. The control system shall conform to all Commonwealth Energy Management and Control System requirements.
- D. Thermostats/Room Temperature Sensors: Each supply air terminal unit requires a thermostat/room temperature sensor for operation, unless specifically indicated on the Drawings to be slaved to another unit. Thermostat/room temperature sensor locations have been identified on the Drawings to the extent possible, but all such locations may not be shown. Provide the required thermostat/room temperature sensors whether or not shown on the Drawings. For those thermostat/room temperature sensors not shown on the Drawings, work out an acceptable location with the Architect/Engineer.
- E. Provide DDC controls for the air terminal units. Provide electronic operators controlled and monitored by direct digital control systems which shall include, but not be limited to, terminal units, terminal unit hot water coil reheat valves, etc.
- F. Provide control sequences specified on the Drawings.
- G. Provide smoke dampers and combination fire/smoke dampers and their motors and controls in accordance with Division 23 Specification Section "Ductwork Accessories".
- H. Provide variable frequency drives and all equipment necessary for proper operation as described in this section.
- I. Provide gas and water meters to monitor gas and water usage.
- J. Provide air terminal units and their controls. Units and regulators shall meet requirements of Specification Section "Air Terminal Units".

- K. Provide electric/electronic operators for valves and dampers. The entire control system shall be electric/electronic.
- L. The control equipment shall be complete and shall include, but not be limited to, all necessary valves, damper operators, pipe, fittings, etc.
- M. Electronic Control System:
 - 1. The new DDC systems in this project must interface to the Niagara AX platform.
 - 2. The integration of the new points with the existing must be invisible during normal daily operation.
 - 3. Windowing between two operator programs is not acceptable.
 - 4. Installer must physically demonstrate to Owner and Owner's representatives before approval of shop drawings that proposed building automation system will function as outlined above.
- N. EMS Connections to Third Party Equipment: Provide the connections and points as indicated in the Sequence of Operation and/or the I/O Summary Sheets. Provide any necessary connection devices not provided by the third party equipment suppliers. Third Party equipment includes but is not limited to, the following:
 - 1. Custom air handling units.
 - 2. HVAC units.
 - 3. Water chillers.
 - 4. Boilers.
 - 5. Emergency generators.
 - 6. Emergency generator transfer switches.
 - 7. Sump pumps.
 - 8. Fire alarm systems.
 - 9. Lighting systems.
- O. Control dampers, in general, located inside custom air handling units, will be furnished by the unit manufacturer. Coordinate with manufacturer to determine extent of their work. All dampers not furnished by the custom air handling unit manufacturer are work of this section. Providing damper operators on dampers, including dampers inside custom air handling units, is work of this section.
 - 1. Refer to Drawings to determine which work is custom air handling unit work and which is field erected work. Control dampers in field erected work (and their operators) are work of this section.
- P. Air handling units are wet environments. Power and control wiring within air handling units shall be in rigid steel conduit and sealed airtight. Junction boxes and enclosures within air handling units shall be threaded cast aluminum with gasketed plate covers. Air handling unit conduit penetrations shall be sealed airtight. Controls (including valve and damper motors) inside air handling units shall be weatherproof.
- Q. Alarm points shall be hard wired and monitored by the Building Automation System.
- R. Line voltage power wiring to emergency showers is work of Division 26. Low voltage wiring to emergency showers is work of this section. See detail on drawings. Provide any material and labor not provided under Section "Plumbing Fixtures".
- S. The control and monitoring system for this project shall be made up using standard materials, equipment and components regularly manufactured for systems of this type. The system shall be complete in every respect and shall be a functioning system.
- T. Electrical power wiring and interlock wiring for all controls, signal devices, alarms, etc., shall be in accordance with diagrams and instructions from the supplier of the systems. All power and control wiring, conduit and wiring connections required for the complete installation, local control panels, power control

modules for elevated floor air terminal units, smoke dampers and combination fire/smoke dampers and their motors, shall be provided by this Contractor in accordance Electrical 26 specification requirements.

- U. Controls shall be connected to emergency power.
 - 1. Electrical power for access floor air terminal units may be obtained from the underfloor electrical distribution system.
- V. Refer to other HVAC Division sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.

1.4 QUALITY ASSURANCE:

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - a. Alerton
 - b. Johnson Controls
- B. Manufacturer shall be responsible for the installation and checkout of control systems.
- C. The installation is to be by the manufacturer or an authorized agent of the manufacturer. The manufacturer is to be ultimately responsible for the installation and the warranty and shall be listed as the installing subcontractor on bid documents.
 - 1. Bids by wholesalers and non-franchised contractors will not be acceptable.
 - 2. The Controls Provider shall have a minimum rated qualification of 5 years of installation experience with the manufacturer and shall provide documentation in the submittal package verifying longevity of the installing company's relationship with the manufacturer.
 - 3. Supervision, calibration and checkout of the system shall be by the employees of the Controls Provider.
 - 4. The Controls Provider shall have a full service facility within Kentucky that is staffed with engineers/technicians trained in Integrating Interoperable Systems and fully capable of providing Lon, Modbus and BACnet programming and instruction.
 - 5. The Controls Provider shall have support within 200 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment to perform routine and emergency maintenance service on all system components.
 - 6. The Controls Provider shall utilize a Niagara AX Framework Certified Technician with a minimum of 3 years programming experience of Niagara AX systems to program the Vykon JACE networked controllers and to configure all attributes of the controlled devices being served up to the College Level Niagara AX Supervisor. Programming shall be implemented in a manner that there are no restrictions on which brands or tools can interact with the system, with the exception of integral factory installed equipment controllers.
 - 7. The Controls Provider's Project Manager and the Niagara AX Framework Certified Technician shall complete a publically accessible training and orientation session on the implementation requirements for the KCTCS Building Automation System that will be offered by the BAS S/C Team.
 - a. A Certification Statement will be issued upon completion of the session.

- b. It is strongly encouraged but not mandatory that the Controls Provider complete this certification prior to bidding the project. It is a requirement that evidence of successful certification be presented with the BAS / Controls submittals.
- c. The owner will not approve the BAS / Controls submittals without this certification.
- D. Where DDC type controls are specified as factory mounted equipment, it is a requirement that the Contractor and the Controls System Supplier be responsible for coordinating all controls, actuators, valve assemblies, and sensors specified are fully compatible and shall be capable of seamless interfacing with all Lon, Modbus and BACnet protocol requirements specified.
- E. User / Operator Proficiency: Project requirements for owner training are as follows:
 - 1. Training Facility; the BAS owner training sessions should take place in part at a KCTCS College computer lab where the computers have been prepared to provide the BAS Trainees ready access to the networks needed for the training content. The trainer shall verify the state of readiness on site with the college IT staff present prior to the training session.
 - 2. User Access; all Trainees shall complete the User Name Application and forward them to Paladin at least 1 week prior to the scheduled training, so that they have access for the training sessions.
 - 3. Training Objectives;
 - a. Level 1 (User) Training Objectives:
 - 1) BAS Login process
 - 2) Navigation from BAS portal to building's graphics and floor plans.
 - 3) Understanding Basic Building Graphics Menus and Links
 - 4) Understanding information presented on floorplan graphics.
 - 5) Understanding of Occupied, Stand-by and Un-occupied room set-points and the role of occupancy sensors with these modes and have the ability to explain these functions to the building occupants, where applicable.
 - 6) Adjustment of room set-points at room sensors and / or graphics as enabled.
 - 7) Timed override commands of scheduled space set-points.
 - 8) Understanding of Alarm categories and appropriate responses to alarms.
 - 9) Quantity of Sessions: Two (Staggered scheduling but duplicate content)
 - 10) Approximate Duration of each Session: 1.5 Hrs.
 - b. Level 2 (Operator) Training Objectives:
 - 1) Attend Level 1 Training.
 - 2) Overview of installed Building Systems, including where applicable:
 - a) Domestic Water
 - b) Air Distribution Classrooms and Offices (Labs as required)
 - c) HVAC hydronic systems and distribution
 - d) Dedicated unitary and terminal systems
 - e) Specialized systems monitored by BAS
 - f) Scheduled lighting
 - g) Electrical power monitoring
 - 3) Understand how to navigate to both system and equipment level graphics from floorplans and other links.
 - 4) Understand what set-point adjustments are available to Operator Level access
 - 5) Understand how to setup a timed Operator Override of a set-point.
 - 6) Understand how to access equipment and BAS documentation.
 - 7) Histories
 - 8) Scheduling Basics
 - 9) Alarms In-depth
 - 10) Quantity of Sessions: Two (Initial + Follow-up Session)
 - 11) Approximate Duration: 2.5 Hrs. each
 - c. Level 3 (Engineer) Training Objectives:
 - 1) Attend Level 1 and Level 2 Training.
 - 2) In-depth understanding of the sequence of operations for each system and custom component:
 - 3) Understand what set-point adjustments are available to Engineer Level access

- 4) Understand how to setup User Access for users
- 5) Scheduling In-depth
- 6) Quantity of Sessions: Three (Initial + two Follow-up Sessions)
- 7) Approximate Duration:
 - a) Level 3 Session 1: 8 Hrs.
 - b) Level 3 Session 2 (follow-up): 4 Hrs.
 - c) Level 3 Session 3 (follow-up): 4 Hrs.
- F. Controls Implementation and Commissioning Final Completion Acceptance Report
 - 1. The S/C Team will perform a compliance review of the BAS between substantial and final completion.
 - 2. Prior to final acceptance the S/C Team must issue an Acceptance Report confirming acceptable completion of the BAS and receipt of the following BAS related items:
 - a. Software & Tools
 - b. Documentation
 - c. Licenses and Programming Niagara AX Compatibility Statement (NiCS).
 - d. Owner Training/Proficiency Report
 - e.

G. Codes and Standards:

- 1. Electrical Standards: Provide electrical components of pneumatic control systems which have been UL-listed and labeled, and comply with NEMA standards.
- 2. NFPA Compliance: Comply with NFPA 90A "Standard for the installation of Air Conditioning and Ventilating Systems" where applicable of controls and control sequences.
- 3. Kentucky Building Code: Comply with requirements where applicable for controls.
- 4. The manufacturer of the temperature control system shall be in compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing).
- 5. Product literature provided by the Temperature Control System Manufacturer shall contain the ISO-9001 Certificate Mark from the applicable registrant.
- 6. Provide products of the temperature control system with the following agency approvals:
 - a. UL-916; Energy Management Systems
 - b. UL-873; Temperature Indication and Regulating Equipment
 - c. UL-864; Subcategories UUKL, OUXX, UDTZ; Fire Signaling and Smoke Control Systems
 - d. CSA; Canadian Standards Association
 - e. FCC, Part 15, Subpart J., Class A Computing Devices
 - f. All products shall be labeled with the appropriate approval markings. System installation shall comply with NFPA, NEMA, NEC, Local and National Codes.

1.5 Coordination Meeting Requirements

- A. BAS Pre-bid Conference: Prior to the project Pre-bid Conference, the owner shall schedule or advertise a BAS Pre-bid Conference (either a scheduled meeting or by web training as KCTCS develops the tool).
 - 1. The purpose of the BAS Pre-Bid (Web) Conference is to familiarize the Controls Provider with the provisions of the Standard Objects Palettes being utilized by KCTCS.
 - 2. The KCTCS BAS Implementation Guide will be made available to the Controls Provider.
 - 3. An understanding of these provisions will help the Controls Provider accurately estimate the programming time savings available with these palettes and services.
 - 4. Attendance to the BAS Pre-bid Conference shall be optional.

- B. HVAC Instrumentation and Controls Scheduling Meeting: This meeting shall be arranged between the General Contractor, Division 23, Division 26, Division 27, Division 28 Sub-contractor, Commissioning Authority, and the Controls System Supplier to establish a Project Work Schedule. This Project Work Schedule is a requirement for Submittal Approval.
- C. Pre-submittal Meeting: This meeting shall be scheduled through the Design Team. The Control Systems Supplier representation shall include the Control system Designer, the System Programmer, and Project Supervisor. A KCTCS S/C Team representative, Design Engineer representative, and a Cx Authority representative shall participate in this meeting. The intent is to:
 - 1. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
 - Coordinate locations for UNC's, Ethernet communication cabling and secure open ports and TCP/IP addresses.
 - 3. Coordinate Point Naming, Graphics, Alarms and System Navigation with the KCTCS S/C Team.
- D. Submittal Review Meeting: At the discretion of the design team, the Control System Supplier's Programmer and Project Supervisor shall meet to review and/or adjust the programming or other portions of the submittal prior to approving or returning the Control system Supplier's submittals. The intent is to:
 - 1. Reconcile any un-certainties such that the control submittal might be approved as a complete set rather than incremental approval steps

1.6 Ownership of Proprietary Materials

- A. i. Controller Software / Toolkits / Licenses Ownership
 - 1. It is a requirement that the ownership of all BAS controllers, software and licenses be in the name of KCTCS.
 - 2. All programming intellectual property associated with the KCTCS BAS software shall be tendered to and owned by KCTCS with full disclosure.
 - 3. KCTCS shall be provided a copy of all tools kits required to operate, adjust and program all BAS products.
- B. Warranties of all BAS Hardware shall be in the name of KCTCS.
- C. KCTCS shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to KCTCS as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of KCTCS. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

1.7 BAS / IT Network Requirements

- A. KCTCS IT Standards apply to all elements of BAS installation where the BAS / Control device is networked on the KCTCS IT network.
- B. Where sub-networks are established for communication between the networked controllers and lower level controllers or devices; the Division 26 low voltage cabling, identification, pathways, and other applicable specifications shall apply.
- C. The coordination of IP addresses, porting and other networking requirements shall be through the KCTCS project manager or S/C Team representative as designated by the project manager.

CONTRACT

D. Controls Provider Access

- 1. An authorized Controls Provider Technician / Engineer will be granted VPN Access to only the building under contract. User Name and Password credentials will be provided to the appropriate service technicians.
- The Controls Provider's network must meet certain IPsec requirements, access outside this IPsec 2. network will be denied.
- Password strength must meet certain minimum requirements and will be updated on a schedule per 3. KCTCS.
- 4. Access will only be available until the Contract warranty period expires.

1.8 SYSTEM PERFORMANCE

Building automation performance requirements: A.

- 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
- 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
- 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
- Object Scan: Transmit change of state and change of analog values to control units or workstation 4. within six seconds.
- 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
- 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
- 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
- 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows: DEBODE DANCE

| VARIABLE | REPORT RANGE | CONTROL |
|------------------------------|-----------------------|-----------------------|
| | | RANGE |
| Water Temperature | +/5°F (0.25°C) | +/- 2°F |
| Water Flow | +/- 2% of full scale | +/- 5% of full scale |
| Water Pressure | +/- 1% of full scale | +/- 2% of full scale |
| Space Temperature | +/- 1°F (0.5°C) | +/- 3°F |
| Ducted Air Temperature | +/5°F (0.25°C) | +/-1°F - 2°F |
| Outside Air Temperature | +/- 1°F (.5°C) | N/A |
| Dew Point Temperature | +/- 1°F (.5°C) | +/- 3°F |
| Temperature Differential | +/- 0.25°F (0.15°C) | N/A |
| Relative Humidity | +/- 1% | +/- 3% |
| Airflow (Pressurized Spaces) | +/- 1% of full scale | +/- 3% of full scale |
| Airflow (Measuring Stations) | +/- 2% of full scale | +/- 5% of full scale |
| Airflow (Terminal) | +/- 2% of full scale | +/- 10% of full scale |
| Air Pressure (Space) | +/- 0.01" wg (2.5 Pa) | +/- 0.05" wg |
| Air Pressure (Supply Duct) | +/- 0.1" wg (25 Pa) | +/- 0.2" wg |
| Air Pressure (Return Duct) | +/- 0.01" wg (2.5 Pa) | +/- 0.05" wg |
| Electrical Power | +/- 1% of reading | N/A |

1.9 ACTION SUBMITTALS:

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For adhesives, indicating VOC content.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Label each control device with setting or adjustable range of control.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation and either 1) programming ladder logic diagrams or 2) control logic block diagrams, fully populated with initial setpoint and control values.
 - 6. Schedule of dampers including size, leakage, torque requirements and flow characteristics.
 - 7. Schedule of valves including flow characteristics.
 - 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and scaled floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - d. Points list.
 - 9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - a. Control System Software:Summary List of "Standard Objects" Graphic Palettes being utilized.
 - b. Summary List of points to be displayed on each "Standard Object" Graphic
 - c. Summary List of all Custom Graphics to be developed by the KCTCS S/C Team.
 - 1) Floor Plans
 - 2) System Schematics
 - 3) Custom Equipment
 - Etc.
 - d. Summary List of points to be displayed on these Custom Graphics.
 - e. Other Graphic Requirements as outlined in BAS Graphics Coordination paragraph and as defined during the Pre-Submittal meeting.
 - 10. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with Lon, Modbus and BACnet standards.
 - 11. Qualification Data: For Installer, manufacturer and Niagara AX Certified Technician.

12. Project Work Schedule: Provide a Gantt or Critical Path Work Schedule developed in conjunction with the General Contractor, Divisions 23, 26, 27, and 28 Sub-contractors demonstrating the plan to have the HVAC systems installed and operational in ample time to complete functional performance tests prior to the substantial completion deadline; and ample time between substantial and final completion for the S/C Team to complete a compliance review.

1.10 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer and Niagara AX and/or Niagara 4 Certified Technician.
- B. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- C. Field quality-control test reports.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Instructions:
 - 1. This contractor shall prepare three (3) loose-leaf, bound brochures, entitled "Automatic Control and Monitoring Systems Operation and Maintenance Data." Mark identification on both front and spine of each binder. Each binder shall be a heavy duty 3-ring, vinyl-covered binder with pocket folders for folded sheet information. Binders shall be properly indexed (thumb-tabbed).
 - 2. Each brochure shall contain the following information:
 - a. Name and address of Consulting Engineer, Contractor, and index of equipment, including vendor (name and address).
 - b. Complete brochures, descriptive data and parts list, etc., on each piece of equipment, including all approved shop drawings.
 - c. Complete maintenance and operating instructions, prepared by the manufacturer, on each major piece of equipment.
 - d. Complete shop drawing submittal on temperature and monitoring controls including control diagrams updated to reflect "as-built" conditions.
 - e. All wiring and component schematics necessary for Owner to troubleshoot, repair and expand the system.
 - f. All brochures shall be submitted to the Architect prior to final inspection of the building.
 - g. Provide a framed set of schematic drawings and sequence of operation to be hung at each local panel and at the central computer as directed by the Engineer.
 - h. Interconnection wiring diagrams with identified and numbered system components and devices.
 - i. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - j. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - k. Calibration records and list of set points.
- B. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Software license required by and installed for DDC workstations and control systems.

6. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

1.12 DELIVERY, STORAGE AND HANDLING:

- A. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons while shipping, storage and handling as required to prevent equipment damage and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.
- B. Store Phoenix controls in a place that is heated and ventilated. Maintain 40°F minimum temperature in cold weather. Do not allow temperature to exceed 120°F in warm weather.
- C. System Software: Update to latest version of software at Project completion.

1.13 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division Section "Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate equipment with Division Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- E. Coordinate equipment with Division Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- F. Coordinate equipment with Division Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- G. Coordinate equipment with Division Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- H. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 DIRECT DIGITAL CONTROL SYSTEM

A. General: This specification defines the minimum hardware and performance requirements for a computer-based building automation system to be furnished and installed.

2.2 SCOPE OF WORK:

A. System Requirements:

- 1. Contractor shall provide all equipment, engineering and technical specialist time to check the installation required for a complete and functioning system. The contractor shall furnish and install all interconnecting system components. Components to include, but not be limited to: printers, power line conditioners, field panels, sensors, motor starter interfaces, and any other hardware items not mentioned above but required to provide the Owner with a complete workable system.
- 2. Any feature or item necessary for complete operation, trouble-shooting, and maintenance of the system in accordance with the requirements of this specification shall be incorporated, even though that feature or item may not be specifically described herein. This shall include hardware and software.
- 3. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall be thoroughly tested and proven in actual use.

B. Input/Output Summary:

- 1. The system as specified shall monitor, control and calculate all of the points and functions as listed in the Input/Output Summary.
- 2. The system as installed shall have sufficient computer memory and application software for 5000 point capacity of the same type and combination as the points listed in the Input/Output Summary.

C. System Start-Up and Acceptance:

- 1. Upon completion of the installation, the Building Automation System (BAS) Contractor shall start-up the system and perform all necessary testing and debugging operations. An acceptance test in the presence of the Owner's representative shall be performed. The vendor shall check all sensors that exhibit any problems or faulty reading. When the system performance is deemed satisfactory in whole, the system parts will be accepted for beneficial use and placed under warranty.
- 2. The BAS Contractor is responsible for the generation of the graphics not provided by owner. An acceptance test shall be performed for the Owner's representative.

D. Owner's Instruction:

- 1. The BAS Contractor shall provide three copies of an operator's manual describing all operating and routine procedures to be used with the system. This user's manual should contain subjects such as: standard operation, error message explanations, software usage, commands, system troubleshooting, etc. The BAS Contractor shall also provide wiring schematics for all system components.
- 2. The BAS Contractor shall instruct the Owner's designated representatives in these procedures during the start-up and test period. These instructions are to be conducted during normal working hours at the Owner's convenience and are to be prearranged with the Owner.
- 3. The instructions shall consist of both hands-on and classroom training at the job site.
- 4. In addition to training previously defined, the BAS Contractor shall also provide additional training for the Owner's chief operators. This training shall be an additional 24 hours at the Owner's location three months after installation acceptance. Upon completion, the attendees shall be able to operate the system and implement system changes including start-up, boot load, color graphic generation, add point to the data base, enter messages, and down line load field units.
- 5. The initial training session shall be scheduled and executed prior to project Final Completion date. The remaining hours allocated for training (dependent on recommendation from SC Team during Phase B review) shall be scheduled and executed at Owner designated intervals during the Warranty period.
- 6. Training shall be performed in a controlled classroom environment where Owners Representatives can access the BAS through workstations or PCs. The user service, prototypes, and permissions shall be set up prior to training to provide appropriate access and visual information to the trainees.
- 7. Train the designated staff of Owner and Owner's Representatives to achieve the objectives of the User / Operator Proficiency requirements outlined in the Quality Assurance section.
- 8. Present & Document content in digital format for each level of training, in modular format:

- a. The three levels of training will generally be organized around:
 - 1) User Access; designed for those needing read only access to building system information, with minimal set-point adjustment authorization.
 - Operator Access (low to medium): designed for those authorized to make limited write adjustments to set-points and schedules.
 - 3) Operator Access (medium to high); designed for those authorized to make substantial write and invoke level adjustments to the BAS.
- 9. Make digital content accessible at the Read-Only user level through the BAS browser.

E. Warranty and Maintenance Requirements

- 1. All components, system software, and parts furnished and installed by the Control Systems Supplier shall be guaranteed against defects in materials and workmanship for one (1) year of substantial completion unless extended warranty by owner or manufacturer is greater than one (1) year. Labor to repair, re-program, or replace these components shall be furnished by the Control Systems Supplier at no charge during normal working hours during the warranty period.
- 2. Materials furnished but not installed by the Control Systems Supplier shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation.
- 3. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks.
- 4. The Control Systems Supplier shall respond to the owner's request for warranty service within forty-eight (48) standard working hours. Emergency service shall be available within twenty-four (24) hours.
- 5. Any changes made to the control system, including set-points, programming, schedules, or calibrations shall be documented on the Owner's work order to clarify the adjustments made in addition to updating user documentation.
- 6. Service Contract Provider Transition Acceptance Report: After project Final Completion, KCTCS will transition preventative maintenance responsibilities to their current Service Contract Provider (outside the project contract). Prior to acceptance of these responsibilities the Service Contract Provider will inspect the facility and issue a Service Contract Provider Transition Acceptance Report. The design team shall review the findings of this report and work with the commissioning and contracting teams to resolve appropriate project warranty related issues.
- 7. Building Automation System Warranty Transition Requirements: Before project close-out:
 - . The BAS Standards & Compliance Team will be provided a copy of the:
 - 1) Commissioning Report
 - 2) Design Team Final Warranty/ Closeout Report
 - 3) Service Contractor Transition Acceptance Report
 - b. As a provision of the project closeout, the BAS Standards & Compliance Team will issue a Project Closeout Acceptance Report indicating the BAS is performing consistent with the project requirements.

F. DDC EQUIPMENT

- 1. Application Software:
 - a. I/O capability from operator station.
 - b. System security for each operator via software password and access levels.
 - c. Automatic system diagnostics; monitor system and report failures.
 - d. Database creation and support.
 - e. Automatic and manual database save and restore.
 - f. Dynamic color graphic displays with up to 10 screen displays at once.
 - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - h. Alarm processing, messages, and reactions.

- i. Trend logs retrievable in spreadsheets and database programs.
- j. Alarm and event processing.
- k. Object and property status and control.
- 1. Automatic restart of field equipment on restoration of power.
- m. Data collection, reports, and logs. Include standard reports for the following:
- 2. Current values of all objects.
 - 1) Current alarm summary.
 - 2) Disabled objects.
 - 3) Alarm lockout objects.
 - 4) Logs.
- 3. Custom report development.
 - a. Utility and weather reports.
 - b. ASHRAE Guideline 3 report.
 - c. Workstation application editors for controllers and schedules.
 - d. Maintenance management.
- 4. Custom Application Software:
 - a. English language oriented.
 - b. Full-screen character editor/programming environment.
 - c. Allow development of independently executing program modules with debugging/simulation capability.
 - d. Support conditional statements.
 - e. Support floating-point arithmetic with mathematic functions.
 - f. Contains predefined time variables.
- G. Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration as follows:
 - 1. Processor: 4th Generation Intel® Core" i3-4030U processor (3M Cache, 1.9 GHz)
 - 2. Dimensions (H/W/D): 17" (4c/40WHr) w/non-touch: 1.1"-1.1"/16.3"/11.2"
 - 3. Weight: 17(4c/40WHr batt): 7.01 lb (3.18 Kg) with FHD touch screen / 6.33 lb (2.87 Kg) with HD+ non-touch
 - 4. Display: LED Backlit Touch Display with FHD resolution (1920 x 1080)
 - 5. System Memory: Up to 8GB memory (Inspiron 17 only)
 - 6. Graphics Option: Intel® HD Graphics 4400 (std on 4th Gen Intel® Core" i3/5/7 CPUs)
 - 7. Optical Drive: Built-in DVD+/-RW
 - 8. Keyboard/Touchpad: Full size, spill-resistant keyboard with 10-key numeric keypad
 - 9. Connectivity Options:
 - a. 10/100 RJ-45 Ethernet network
 - b. Intel® Dual Band Wireless-AC 7260 (2x2) + Bluetooth 4.0
 - 10. Ports and Connectors: HDMITM 1.4a, USB 3.0 (2), USB 2.0 (1), Security slot, Media Card (SD, SDHC, SD3.0, MS, MS Pro)
 - 11. Inspiron 17 5000 Series Claims (HASWELL): The Inspiron 17 5000 Series has up to 5 hours 55 minutes of Mobile Mark 12 battery life when equipped with Intel CoreTM i3-4020U processor, Intel HD Graphics 4400, 4 GB DDR3L system memory, 500 GB HDD, HD+ display and 4-cell 40 WHr battery, as tested by Dell labs in March, 2014. Config: CEDAR171503_2402
- H. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

- 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
- 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
- 3. Global communications.
 - a. Discrete/digital, analog, and pulse I/O.
 - b. Monitoring, controlling, or addressing data points.
 - c. Software applications, scheduling, and alarm processing.
 - Testing and developing control algorithms without disrupting field hardware and controlled environment.
- 4. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
 - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - e. Remote communications.
 - f. Maintenance management.
 - g. Units of Measure: Inch-pound and SI (metric).
- 5. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- I. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 - 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- J. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 - 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 - 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 - 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.

- 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
- 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
- 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
- 7. Universal I/Os: Provide software selectable binary or analog outputs.
- K. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 - 1. Output ripple of 5.0 mV maximum peak to peak.
 - Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 - 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- L. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
 - 1. Minimum dielectric strength of 1000 V.
 - 2. Maximum response time of 10 nanoseconds.
 - 3. Minimum transverse-mode noise attenuation of 65 dB.
 - 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.3 Network Controller Standards (BAS Level 2 Field Cabinets)

- A. The BAS Network Controllers shall be an open protocol / open distribution controller.
 - 1. For construction projects the network controllers shall be Vykon JACEs, Owner Furnished Contractor Installed. Programming shall include an open Niagara AX Compatibility Statement (NiCS).

2.4 Custom Application Controllers

- A. Custom Application Controllers applied to specific equipment shall include a standard open communications interface of either BACnet-IP, BACnet-MSTP, Modbus TCP, Modbus-Async (Serial), or Lon (EIA Standard 709.1) protocol.
- B. Mechanical and Electric Equipment with integrated factory controllers shall include a standard open communications interface of either BACnet-IP, BACnet-MSTP, Modbus TCP, Modbus-Async (Serial), or Lon (EIA Standard 709.1) protocol.
- C. Modular and Custom Air Handling Unit Controls may be factory mounted, but in such cases, the Custom Application Controller shall be furnished and programmed by Controls Provider and of the same manufacturer as other Custom Application Controllers and Application Specific Controllers used for the project.
- D. Variable Frequency Drives shall include a standard open communications interface of either BACnet-IP, BACnet-MSTP, Modbus TCP, Modbus-Async (Serial), or Lon (EIA Standard 709.1) protocol.

2.5 Zone Control Standards (BAS Level 1)

- A. Application Specific Controllers
 - 1. Application Specific Controllers shall be of the same manufacturer for a given building (mixed controls manufacturers within a given building requires written approval by the KCTCS project manager).
 - 2. Application Specific Controllers shall include a standard open communications interface of either BACnet-IP, BACnet-MSTP, or Lon (EIA Standard 709.1) protocol.

2.6 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 - 3. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

2.7 VAV MODULAR ASSEMBLY (VMA)

- A. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
- B. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 1. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - 2. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
- C. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol.
- D. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
- E. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
- F. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 60 seconds.
- G. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
- H. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

- I. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
- J. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
- K. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.

L. Inputs:

- 1. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - a. 0-10 VDC Sensors
 - b. 1000ohm RTDs
 - c. NTC Thermistors
- 2. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
- 3. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
- 4. Provide side loop application for humidity control.

M. Outputs

- 1. Analog outputs shall provide the following control outputs:
 - a. 0-10 VDC
- 2. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
- 3. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

N. Application Configuration

1. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

2.8 CONTROL PANELS

- A. Panelboard shall contain all instruments and accessories. Provide each item of equipment with an engraved nameplate. Panelboard shall be wall-mounted or stand-mounted and shall be completely enclosed.
- B. As far as is practical, the control components for each system shall be grouped. Provide each group of components with identification.
- C. The entire panelboard shall be pre-wired and brought to a main terminal strip. All relays, switches, etc., shall be installed, furnished and wired on panelboard. Clearly mark each terminal strip as to which wire from which component is to be connected.
- D. Fabricate panels of 0.06-inch- (1.5-mm-) thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color.

- E. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
- F. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
- G. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.

2.9 VARIABLE FREQUENCY DRIVES:

A. Basic Description:

- 1. The variable frequency drive (VFD) shall be solid state, with a Pulse Width Modulated (PMW) output waveform (VVI, six-step, and current source drives are not acceptable). The VFD package as specified herein shall be enclosed in a single NEMA 12 enclosure, completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device (SCR's, GTO's and Darlington transistors are not acceptable). The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
- 2. The VFD shall be specifically designed for variable torque, centrifugal load applications. The Control System Contractor shall perform the following functions from the FMS: remote bypass/auto switching, stop/start, remote speed adjustment, error monitoring and actual speed readout.
- 3. The VFD shall be suitable for use with any standard NEMA-B squirrel-cage induction motor having a 1.15 or more service factor, or with existing standard NEMA-B squirrel-cage induction motor with nameplate data as shown on the plans. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage and RPM) in the field.
- 4. Output voltage regulation shall be plus-or-minus 1 per cent from no load to full load.
- 5. When input speed command is lost, the drive shall continue operation at either last speed command, minimum speed, or a preset speed as determined by the operator.
- 6. The VFD shall be capable of starting into a spinning load with complete protection and promptly return the motor to set speed. It shall also be capable of bringing windmilling loads to a stop prior to accelerating load in the proper direction by such means as injection braking.
- 7. All programmable settings, including self diagnostic fault data, shall be held in non-volatile memory and shall not be affected by power outages, brownouts, power dips, etc. The AFD shall have initial programmable settings intact from the factory without the need of battery backup, etc. The start-up technician shall program each AFD to the motor for which it is connected.
- 8. Programming at the job site to accommodate specific local application requirements, such as frequency avoidance and preset speeds shall be available to the user.
- 9. Complete efficiency versus load and speed for all VFD ratings shall be readily available from the manufacturer. VFD multiple motor operation at the same frequency and speed shall be possible as long as the sum of the connected motor full load sine wave currents are less than or equal to 90% of the VFD maximum continuous current rating.
- 10. All high voltage components within the enclosure shall be supplied, protected or enclosed in a method that makes them safe.

B. Codes/Standards:

- 1. VFD and options shall be UL listed.
- 2. The controller and options shall comply with the applicable requirement of the latest standards of ANSI; NEMA ICS-6 for controls and systems; National Electric Code NEC; IEC 801-2, 801-4, 256-4.

- C. Quality Assurance: The VFD controller shall be subject to but not limited to the following quality assurance controls, procedures and tests.
 - 1. The manufacturer shall have been actively and continuously engaged in the production of adjustable frequency controllers for a period of at least 10 years and have experience of at least 8 years in commercial HVAC applications.
 - 2. Every VFD shall be functionally tested under motor load and must pass a 4-hour minimum heat run under motor load.

D. MAINTENANCE MATERIAL SUBMITTALS

- 1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 3 of each size and type.
 - b. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 2 of each size and type.
 - c. Indicating Lights: 2 of each type and color installed.
 - d. Auxiliary Contacts: 1 spare for each size and type of magnetic controller installed.
 - e. Power Contacts: 3 spares for each size and type of magnetic contactor installed.

E. Variable Frequency Drive:

- 1. The VFD manufacturer shall provide, at minimum, the electromechanical construction, basic features, adjustments, general options and modifications and special options as outlined in this specification.
- F. Basic Features: The VFD shall have the following basic features:
 - 1. Variable Frequency Drive shall be mounted in a NEMA 12 enclosure.
 - 2. The VFD shall incorporate a full 20 character minimum, alpha/numeric customer interface panel showing all settings, parameters, operating screens, operating data, supervision information and faults in plain English. VFD's employing codes and abbreviations shall not be acceptable.
 - 3. Operators controls shall be mounted on the door of the cabinet and consist of a membrane command center which allows manual stop/start and speed control, local/remote indication and manual/or automatic speed control selection. In addition, the command center will serve as a means to configure controller parameters such as minimum speed, maximum speed, acceleration and deceleration times, volts/Hz ratio, torque boost, etc. Potentiometers will not be allowed for these settings.
 - 4. For ease of Owner and TCC use, the VFD shall also incorporate a speed potentiometer for manual speed control and a hand-off-auto selector switch. Membrane/keypad functions can also be utilized to perform these functions.
 - 5. The controller will be able to follow an external speed signal and respond to remote start/stop contacts wired to the terminal strip while in the automatic/remote mode.
 - 6. Disconnect: Door interlocked fused disconnect shall interrupt all input power from the drive and all internally mounted options. The disconnect handle shall be through-the-door type and shall be padlockable in the "OFF" position.
 - 7. The controller shall contain a U.L. electronic overload circuit designed to protect the A-C motor, operated on the adjustable frequency controller output from extended overload operation on an inverse time basis. A motor thermostat back-up may also be provided.
 - 8. The VFD shall also incorporate programmable protection settings for motor stall, motor under-load, and motor at speeds to protect the motor in applications requiring less than full load/full speed motor requirements.
 - 9. The VFD shall have two programmable/selectable analog inputs which will accept current or voltage input signals for speed reference or for manual put reference or for actual feedback signals

- for use of the VFD built in proportional integral controller. These analog inputs shall be programmable for filtering, gain and offsets. The VFD shall incorporate a loss or analog input circuit which is programmable and can not only send an external output warning (DO), but also determine a preset speed of the VFD for safety purposes.
- 10. Automatic restarts will be attempted three times after a power outage, drive fault, safety shutdown such as freezestat or firestat, or external fault, if the drive is in automatic mode. The circuit shall allow the user to select 0, 1, 2 or 3 restart attempts as well as select the dwell time between attempts. The reset time between fault occurrences shall also be selectable. All settings shall be via the membrane command center.
- 11. The following operating information shall be available to be displayed on the VFD's 20 character (minimum) full alphanumeric display:
 - a. Output frequency
 - b. Output RPM/speed (programmable)
 - c. Motor currents
 - d. Calculated motor power calculated
 - e. KwHr meter
- 12. There shall be a minimum of two critical frequency avoidance bands which can be programmed in the field via the membrane command center to enable the controller to avoid certain frequencies which the pump or fan system may resonate at due to reduced speed operation.
- 13. There shall be seven programmable preset speeds which will force the VFD to a preset speed upon a user contact closures. This feature shall be set digitally by entering via the door mounted membrane command center.
- 14. Disconnecting the motor for free wheeling operation in periods of power outage is not acceptable.
- 15. To prevent unnecessary trips, include a speed droop feature which reduces the speed of the drive on transient overload. The drive is to return to the set speed after the transient is removed. Should the acceleration or deceleration rates be too rapid for the moment of inertia of the load, the drive is to automatically compensate to prevent drive trip.
 - a. Voltage dip ride through: The VFD shall be capable of sustaining operation with a 30% dip in nominal line voltage. Output speed may decline only if current limit rating of the VFD is exceeded.
 - b. Power loss ride through: The VFD shall be capable of a 5 cycle power loss ride through without fault activation.
- 16. Compliance to IEEE 519 -- Harmonic analysis for particular jobsite including total voltage harmonic distortion and total current distortion.
- G. Manufacturer shall perform and submit calculations, specific to this project, which show that the theoretical line notching and voltage distortion comply with IEEE-519, Special Applications Criteria (10% notching, 3% distortion). If line notching and/or voltage distortion exceed these values, then provide equipment to provide this level of filtration. Obtain information for sizing line filtering equipment (such as transformer sizes and impedances, feeder sizes, capacitor locations, etc.) from Electrical Plans or from General Contractor/Electrical Contractor.
- H. Protective Circuits and Features: The VFD shall include the following protective circuits and features:
 - 1. Fast acting semiconductor fuses specifically sized for protection of the AFC.
 - 2. DV/DT and DI/DT protection for semiconductors.
 - 3. Instantaneous Electronic Trip for the following faults:
 - a. Motor current exceeds 110% for longer than one minute of controller maximum sine wave current rating
 - b. Output phase-to-phase circuit condition
 - c. Total ground fault under any operating condition

- d. High input line voltage
- e. Low input line voltage
- I. The VFD shall have the following protection circuits and display on the 20 character alphanumeric display the appropriate faults. Fault notification must be in plain English. Fault codes are not acceptable.
 - 1. Overcurrent trip device to continuously monitor peak currents and provide instantaneous shutdown without component failure when the high limit is surpassed.
 - 2. Over-voltage trip -- selectable to protect motor AFC
 - 3. Under-voltage trip -- 65% of AFC rating
 - 4. Ground fault -- Running on start at motor
 - 5. Motor overload I²T -- UL-NEC-overload
 - 6. Motor under-load trip -- warning or fault
 - 7. VFD overtrip -- Over heat sink limits
- J. Three "last faults" shall be kept in non-voltage memory for ease of troubleshooting.
 - 1. Metal oxide varistors.
- K. Adjustments: The following adjustments shall be followed:
 - 1. Maximum frequency (0 to 120 Hz) with factory setting at 60 Hz.
 - 2. Minimum frequency (0 to 60 Hz) with factory setting at 6 Hz.
 - 3. Acceleration (2 to 3200 seconds) factory set at 60 seconds.
 - 4. Deceleration (2 to 3200 seconds) factory set at 60 seconds.
 - 5. Adjustable U/Hz, U/Hz² and automatic H/Hz⁽²⁾ setting for energy savings.
 - 6. Voltage offset or boost with factory setting at 100% torque.
 - 7. Current limit (50 to 100%) sine wave current rating factory set at 100%.
- L. Service Conditions: The VFD shall be designed and constructed to operate within the following service conditions:
 - 1. Suitable for continuous operation at an ambient temperature of 0°C. to 40°C. Elevation up to 3300 feet altitude with a relative humidity to 95% non-condensing.
 - 2. A-C line variation of 440 vac + 10% 5% frequency.
- M. Controlled equipment shall have dual variable frequency drives in common cabinet.
- N. Installation:
 - 1. Installation shall be the responsibility of the Mechanical Contractor. The Contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
 - 2. Power wiring shall be completed by the Electrical Contractor. The Contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
 - 3. This Contractor shall be responsible for interlock with remote disc.
- O. Start-Up:
 - 1. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer.
- P. Electrical Power -- Three phase, 60 cycle, 460 volts.

- Q. Manufacturers: Select a manufacturer from the following listing:
 - 1. ABB Industrial Systems, Inc.
 - 2. Danfoss-Graham
 - Yaskawa
 - 4. Square D

2.10 ELECTRONIC SENSORS

- A. See "THERMOSTATS/TEMPERATURE SENSORS" paragraph for specifications on room type temperature sensors.
- B. See "HUMIDISTATS/HUMIDITY SENSORS" paragraph for specifications on room type humidity sensors.
- C. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- D. Thermistor Temperature Sensors and Transmitters:
 - 1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. Ebtron, Inc.
 - c. Heat-Timer Corporation.
 - d. I.T.M. Instruments Inc.
 - e. MAMAC Systems, Inc.
 - f. RDF Corporation.
 - 2. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
 - 3. Wire: Twisted, shielded-pair cable.
 - 4. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 - 5. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
 - 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

E. RTDs and Transmitters:

- 1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. MAMAC Systems, Inc.
 - c. RDF Corporation.
- 2. Accuracy: Plus or minus 0.2 percent at calibration point.
- 3. Wire: Twisted, shielded-pair cable.
- 4. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
- 5. Averaging Elements in Ducts: 18 inches (460 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.

- Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
- 7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Concealed.
- 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- 9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- 10. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
- 11. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F (minus 30 to plus 85 deg C).
- 12. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

F. Pressure Transmitters/Transducers:

- 1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
- 2. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
 - d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
- 3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
- 4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
- 5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
- 6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.11 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0-to 5-inch wg (0 to 1240 Pa).
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
 - 1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. I.T.M. Instruments Inc.

2.12 THERMOSTATS/TEMPERATURE SENSORS:

- A. DDC Room Thermostats/Sensors: Provide room thermostats that work in conjunction with the DDC terminal unit controllers. Thermostats shall have visible thermometers, setpoint indication and exposed setpoint adjustment knobs in all areas except public spaces.
 - 1. Visible thermometers, as specified on the appropriate thermostats, shall be digital and display the same temperature value as transmitted and displayed at remote monitoring stations. Displays on thermostats shall also be programmable and concealable. Separate cover mounted, bimetal or mercury thermometers will not be acceptable.
 - 2. The room thermostat/sensor setpoint shall be capable of being shared by up to 31 VAVDC's, providing coordinated control of zones containing multiple VAVDC's. In cases where a single room sensor is to be shared by multiple controllers and the system cannot accommodate the functions; a wall sensor with multiple sensing elements and a ganged setpoint adjustment, under a single sensor, shall be employed. The room sensor shall contain a push-button for override of unoccupied conditions, an RJ-11 plug-in communications jack for connection of the HHOT and a setpoint adjustment knob.
 - 3. An RJ-11 type connection to serial port shall allow a local portable operator or programmers terminal to access all program blocks and attributes for complete programmability.
- B. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - 1. Zone Temperature
 - 2. Zone Humidity
 - 3. Zone Setpoint
 - 4. Discharge Air Temperature
 - 5. Zone CO2

- C. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
- D. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 1. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
 - 2. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
 - 3. The Conformance Statement shall be submitted 10 days prior to bidding.
- E. The Network Zone Temperature Sensors shall include the following items:
 - 1. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint
 - 2. An LED to indicate the status of the Override feature
 - 3. A button to toggle the temperature display between Fahrenheit and Celsius
 - 4. A button to initiate a timed override command
 - 5. Available in either surface mount or wall mount
 - 6. Available with either screw terminals or phone jack
- F. The Network Discharge Air Sensors shall include the following:
 - 1. 4 inch or 8 inch duct insertion probe
 - 2. 10 foot pigtail lead
 - 3. Dip Switches for programmable address selection
 - 4. Ability to provide an averaging temperature from multiple locations
 - 5. Ability to provide a selectable temperature from multiple locations
- G. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
- H. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snapswitch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed setpoint adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- I. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.
 - 2. Bulbs in air ducts with flanges and shields.
 - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 - 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- J. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

- K. Electric, Low-Limit Duct Thermostat (Freezestat): Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
 - 1. Bulb Length: Minimum 20 feet (6 m).
 - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
 - 3. Reset: Manual, with adjustment located outside of air handing systems, laboratory exhaust systems and heat recovery systems.
- L. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
 - 1. Bulb Length: Minimum 20 feet (6 m).
 - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
 - 3. Reset: Manual, with adjustment located outside of air handing systems, laboratory exhaust systems or heat recovery systems.

2.13 HUMIDISTATS/HUMIDITY SENSORS

- 1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
- B. Duct-Mounted Humidistats: Electric insertion, 2-position type with adjustable 2 percent throttling range, 20 to 80 percent operating range, single- or double-pole contacts.
- C. DDC Humidity Sensor/Transmitter: The humidity sensor shall consist of resistance change through bulk polymer. The transmitter shall consist of an electronic amplifier with factory set span and calibration adjustments. All components shall be mounted on a printed circuit board. Room humidity sensor/transmitter shall match appearance of room temperature transmitter or thermostat. Room humidity transmitter shall be provided with a control range of 0 to 100% RA +2% and produce a two wire, to 20 mA direct acting signal. Duct humidity sensor/transmitter shall be similar to room units except they shall be mounted in a NEMA I enclosure.
 - 1. Accuracy: 5 percent full range with linear output.
 - 2. Room Sensor Range: 20 to 80 percent relative humidity.
 - 3. Room Sensor Cover Construction: Manufacturer's standard locking covers.

2.14 GLOBE TYPE CONTROL VALVES:

- A. Available Manufacturers:
 - 1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
 - 2. Erie Controls.
 - 3. Hayward Industrial Products, Inc.
 - 4. Magnatrol Valve Corporation.
 - 5. Neles-Jamesbury.

- 6. Parker Hannifin Corporation; Skinner Valve Division.
- 7. Pneuline Controls.
- 8. Sauter Controls Corporation.
- B. Provide factory fabricated control valves of type, body material and pressure class indicated. Equip control valves with heavy duty industrial type actuators where required to insure that valve close-off ratings will meet or exceed scheduled values. Provide spring-loaded Teflon, self-adjusting packing.
- C. Control valves shall be fully proportioning and provide near linear heat transfer control. Valves shall fail in last position unless otherwise specified. Valve stems shall be stainless steel.
- D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
 - 2. Leakage: ANSI Class IV.
 - 3. Sizing: As scheduled on the Drawings.
 - 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - 5. Close-Off (Differential) Pressure Rating: As scheduled on the Drawings.
- E. Hydronic system valves shall be globe type and shall have the following characteristics:
 - 1. NPS 2 (DN 50) and Smaller: Class [125] [250] bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 - 2. NPS 2-1/2 (DN 65) and Larger: Class [125] [250] iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 - 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 - 4. Leakage: ANSI Class IV.
 - 5. Sizing: As scheduled on the Drawings.
 - 6. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - 7. Close-Off (Differential) Pressure Rating: As scheduled on the Drawings.

2.15 BALL CONTROL VALVES:

A. Do not use ball type control valves.

2.16 BUTTERFLY TYPE CONTROL VALVES (2-POSITION CONTROL ONLY):

- A. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 - 1. Body Style: Wafer.
 - 2. Disc Type: Nickel-plated ductile iron.
 - 3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.

2.17 SELF-CONTAINED CONTROL VALVES:

- A. Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
 - 2. Thermostatic Operator: Wax-filled integral sensor with integral adjustable dial.

2.18 DAMPERS:

- A. Provide dampers constructed of material suitable for the duct system. Provide galvanized steel dampers in galvanized steel duct systems. Provide aluminum dampers in aluminum duct systems. Provide stainless steel dampers in stainless steel duct systems.
- B. Provide heavy duty industrial type automatic control dampers, Ruskin CD30AF2 or equal, with damper frames not less than 12-gage galvanized steel. Provide mounting holes for enclosed duct mounting. Provide airfoil shaped damper blades not less than formed 16-gage, with maximum blade width of 8". Dampers shall be suitable for use in systems with up to 12 inches total static pressure based on a 60-inch blade width.
- C. Secure blades to 3/4" diameter zinc-plated axles using zinc-plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings of nylon and provide thrust bearings at each end of every blade. Construct blade linkage hardware of zinc-plated steel and brass. Submit leakage and flow characteristics plus size schedule for controlled dampers.
- D. Do not exceed maximum 60"x60" damper size. For sizes larger then this maximum in either dimension, use multiple dampers with a separate operator for each damper. Do not jackshaft separate dampers together.
- E. Operating Temperature Range: From -20 degrees to 200 degrees F. (-29 degrees to 93 degrees C.)
- F. Provide opposed blade design with inflatable steel blade edging, or replaceable rubber seals, AMCA Standard 500 rated for leakage less than 3 CFM/SQ.FT. of damper area, at a differential pressure of 1" W.G.
- G. Smoke Dampers: Provide smoke and combination fire/smoke dampers in accordance with applicable requirements of Specification Section "Ductwork Accessories".

2.19 ELECTRONIC DAMPER ACTUATORS

- A. Electronic damper actuators shall be direct shaft mount.
- B. Provide modulating and two-position actuators as required by the sequence of operations.
- C. Provide actuators (except for air terminal units) with mechanical spring return. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the valves, as required. Provide actuators with external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
- D. Provide actuators with adjustable end switches to indicate open/closed position.
- E. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be

used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

- F. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed.
- G. Equip actuators for outdoor locations and for outside air intakes with "O ring" gaskets designed to make actuators completely weatherproof, and equip with internal heaters to permit normal operation at -40 degrees F. (-40 degrees C.)
- H. Provide separate actuator for each outside air, return air and exhaust air damper. Do not link dampers with different functions together on one damper actuator.
- I. Provide separate actuator for each damper when overall damper size exceeds 60" in either dimension. Do not jackshaft dampers together on one damper actuator.
- J. Binary backed-up actuators are not acceptable.

2.20 ELECTRONIC VALVE ACTUATORS-TERMINAL UNIT HEATING COILS

- A. Provide modulating and two-position actuators as required by the sequence of operations.
- B. Size actuators to operate valves with sufficient reserve power to provide modulating action or 2-position action as specified. Select actuator for full shutoff at the close-off pressures scheduled on the Drawings.
- C. Control: Floating point. Provide automatic recalibration control.
- D. Provide actuators with adjustable end switches to indicate open/closed position.

2.21 ELECTRONIC VALVE ACTUATORS - OTHER

- A. Provide modulating and two-position actuators as required by the sequence of operations.
- B. Size actuators to operate valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified.
- C. Select actuator for full shutoff at the close-off pressures scheduled on the Drawings. Provide heavy duty industrial type actuators where necessary to meet these close-off pressures.
- D. Provide actuators (except for terminal unit heating coil control valves) with mechanical spring return. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the valves, as required. Provide actuators with external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
- E. Provide actuators with adjustable end switches to indicate open/closed position.
- F. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

- G. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed.
- H. Binary backed-up actuators are not acceptable.

2.22 ELECTRIC/ELECTRONIC ACTUATOR RUN TIMES

A. Unless otherwise noted on the Drawings, maximum permissible run times are as follows:

1. Terminal Unit Dampers: 60 seconds.

2. Other Dampers: 30 seconds to open, 12 seconds to close.

3. Terminal Unit Valves: 60 seconds.

4. Heat Exchanger Valves: 12 seconds to open, 5 seconds to close.

5. Other Valves 30 seconds to open, 12 seconds to close.

2.23 FAIL-SAFE OPERATION

A. Unless otherwise noted on the Drawings, fail-safe operation shall be as follows:

1. Terminal Unit Dampers: Last Position.

2. Terminal Unit Valves: Last Position.

3. Heat Exchanger Valves: Closed.

4. Chilled Water Valves: Closed.

5. Heating Valves: Closed.

6. Preheat Coil Valves: Open.

7. Energy Recovery Valves: (Open)(Closed)

8. Outside Air Dampers: Closed.

9. Return Air Dampers: Open.

10. Exhaust Air Dampers: Closed.11. Shutoff Dampers: Closed.

12. Smoke Dampers Closed

2.24 MISCELLANEOUS:

- A. Wells for Pipe Mounted Sensor: Wells shall have minimum working pressure of 150 WOG psig. Wells shall be brass or stainless steel.
- B. Thermometers-Duct: Air thermometers shall be the adjustable angle bimetallic 3-1/2" dial type with stainless steel case (plus or minus 1/4% accuracy). Dial shall be the anti-parallel type with black figures and pointer. A recalibration screw shall be furnished in the case for pointer adjustment. Provide duct flange for mounting and stem length of 8" minimum. Temperature range shall be appropriate for each application.
- C. Provide air thermometers at the following locations:
 - 1. All supply air from air handling units.
 - 2. All outside air to air handling units.
 - 3. In mixed air plenum of each air handling unit.
 - 4. At discharge and entrance of each cooling and/or heat coil.
 - 5. At each duct thermostat or sensor if not located at one of the above.
- D. Pneumatic transmission type thermometers will not be allowed for this project.

- E. Air Pressure Gauges: Furnish and install differential pressure gauges complete with integral tips and valves. Ranges shall be 0-1.0" of water for pre-filter, 0 to 2.0" for final filter, 0-4.0" of water for low pressure fans, 0-10.0" of water for high pressure fans.
- F. Provide air pressure gauges at the following locations.
 - 1. Each filter location on air handling system.
 - 2. Each supply and return fan.
 - 3. Each exhaust fan.
- G. Measuring Stations: Provide stations of sizes and capacities scheduled on the Drawings. Each unit shall consist of casing for mounting in ductwork, air straighteners with aluminum honeycomb to provide laminar flow, static pressure sensors interconnected by a tube header, and total pressure sensors comprised of a network of interconnected tube headers. Total pressure sensors shall be positioned so that each sensing point represents an equal measuring area. Provide total and static pressure external ports with fittings for connecting to external sensor lines.
- H. Fan Flow Measuring Stations: Provide flow measuring stations in supply fan and return fan inlets in variable volume system, equal to Tek-Air Systems, Inc. Stations shall be designed specifically for installation in fan inlets and shall operate on the vortex shedding principle. Stations shall produce an output signal that is linear in relation to airflow velocity.
- I. Status Indication: Status indication shall be done by proving flow in the appropriate water or air system. Do not use interlocks off electric motors or starters for status indication.
- J. Furnish 2-position relays, capacity relays, pneumatic sequencing relays, plus any other controls necessary to meet the specification and provide for a properly operating automatic control system. Electric-pneumatic or pneumatic-electric switches and relays must be U.L. listed and be a type to meet current and voltage requirements of the particular application. Relays shall be the enclosed plug-in type.
- K. Lightning Protection: All electric/electronic equipment supplied must be internally or externally lightning/transient surge voltage protected on all external power feeder and input/output connections which are subject to surge voltage transients. Provide high speed clamping elements which meet IEEE. STD. 472 (SWC) on all digital or analog date channels.
- L. Current Sensing Relays: Relays shall monitor status of motor loads. Switch shall have self-wiping, snapacting Form C contacts rated for application. Setpoint of contact operation shall be field adjustable. Monitor all 3 legs of 3 phase motors.
- M. Low Voltage Wiring: Wiring for electric or electronic circuits less than 25 volts shall be cabling manufactured for express use in air plenums. The plenum cable shall be 24 gauge or larger as required, tinned copper, teflon insulated, twisted pairs, shielded or unshielded, as required, a color coded, overall tape wrap, with transparent teflon jacket, 150V., NEC725, Class 2 classified for use in air plenum non-conduit signalling application.
- N. Manual Override Switches: In case of failure of the DDC system, provide override switches to operate fans, pumps, air handling units, cooling tower, heat exchangers, etc., manually in local interface control panel. Also for temperature and pressure control provide switches to allow supply temperatures, water temperatures, supply air pressure and fans to be manually regulated. All switches shall be located in locked panel to prevent unauthorized use of the manual override switches.
- O. Current Measuring Devices

- 1. Current measurement shall be by a combination current transformer and a current transducer. Size the current transformer to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Building Automation System.
- 2. Current Transformer Provide a split core current transformer to monitor motor amps.
 - a. Operating frequency 50 400 Hz.
 - b. Insulation 0.6 Kv class 10Kv BIL.
 - c. UL recognized.
 - d. Five amp secondary.
 - e. Select current ration as appropriate for application.
- 3. Current Transducer A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
 - a. 6X input over amp rating for AC inrushes of up to 120 amps.
 - b. Manufactured to UL 1244.
 - c. Accuracy: +.5%, Ripple +1%.
 - d. Minimum load resistance 30kOhm.
 - e. Input 0-20 Amps.
 - f. Output 4-20 mA.
 - g. Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AUTOMATIC TEMPERATURE CONTROLS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on the Drawings.
- B. It is intended that the HVAC Instrumentation and Controls wiring be installed and terminated in accordance with Division 26 Requirements, with the following guidelines for signal and communication cable management:
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Existing building cable tray raceways may be utilized, but control cabling shall be of a different jacket color than existing cabling and shall be secured and bundled within the tray separately of other cables.
 - 5. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
 - 6. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 7. Number-code conductors for future identification and service of control system, except local individual room control cables may be color coded.

- 8. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install labels and nameplates to identify control components according to Division 26, Section Identification for Electrical Systems
- D. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- E. Connect and configure equipment and software to achieve sequence of operation specified.
- F. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

3.3 CONTROL WIRING:

- A. Install control wiring, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code. Reference the Division 26 Specifications for conduit material. Install wiring in electrical conduit in areas where wiring is exposed such as the mechanical equipment rooms, chiller/boiler plant etc.
- B. Seal conduit penetrations of air handling units and custom air handling systems airtight. Seal at penetration points.
- C. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

3.4 **POWER WIRING:**

- A. Reference the Division 26 Specifications for conduit material.
- B. Provide power wiring and conduit to air terminal units (if required) and to smoke dampers and combination fire/smoke dampers and their damper motors.
- C. Furnish and install power cabling and conduit for temperature controls from emergency power panels. Each temperature control panel shall be connected to a separate circuit. Conduits shall connect to panels at the locations directed by the Contractor under Division 26. Final connection in the power panels shall be by Control Systems Contractor in coordination with Division 26 Contractor.

3.5 MISCELLANEOUS:

- A. Connect the Digital System Controllers to a remote console. The interconnection, all conduit and transmission cabling, including hardware shall be furnished and installed by this Contractor.
- B. BAS Graphics Coordination (Niagara Web Supervisor Integration projects)
 - 1. BAS Graphics for KCTCS building automation systems generally fall into three categories:

- a. Typical Equipment types: Typical MEP equipment types have had "Standard Object" palettes developed by the KCTCS Capital Project Manager.
 - 1) The palettes include the graphics for this equipment.
 - These owner furnished palettes will be provided to the Controls Provider after project award.
 - 3) These types include fan coils, VAV boxes, heat pumps, and similar equipment.
- b. Custom Equipment types: Custom MEP equipment graphical requirements shall be coordinated with the KCTCS Capital Project Manager.
 - In most instances, these will be developed by the KCTCS Capital Project Manager and will be Owner-furnished palettes provided to the Controls Provider after project award.
 - 2) There may be circumstances where these custom graphics will be developed by the BAS Supplier. In such cases, the BAS Supplier shall utilize widely available Tridium/Niagara workplace graphic tools (specifically the kit Px Graphics Palette) to maintain consistency with those developed in the Standard Object Palettes and must be approved by the KCTCS Capital Project Manager during the submittal process.
- c. Building and Building System level graphics: Building and Building System level graphical requirements shall be coordinated with the KCTCS Capital Project Manager..
 - 1) In most instances, these will be developed by the Team and will be added to the College Level Server by the Team.
 - 2) There may be circumstances where these custom graphics will be developed by the BAS Supplier. In such cases, the BAS Supplier shall utilize widely available Tridium/Niagara workplace graphic tools (specifically the kit Px Graphics Palette) to maintain consistency with those developed in the Standard Object Palettes and must be approved by the KCTCS Capital Project Manager during the submittal process.
- d. The Controls Provider shall map and integrate controls points from the devices and equipment onto the graphics provided/developed.
- 2. Controls Provider's BAS Graphics Responsibility
 - a. The Controls Provider will be responsible for linking the building-level control points to the JACE level Standard Object modules using the KCTCS Standards Objects palette. The Controls Provider will need to support the integration of the networked JACE's into the college-level Niagara AX or Niagara 4 Supervisor server. This includes, but is not limited to, responsiveness to the JACE commissioning review, communication to confirm networking, availability to review custom systems that do not meet standard configuration.
- C. BAS Graphics Coordination Automated Logic WebCTRL Integration projects (WC7.0 or later)
 - 1. WebCTRL software minimum, features and add-ons include:
 - 2. Security. The web server application shall support Transport Layer Security (TLS) with a capability of 256-bit encryption for transmitting private information over the Internet using HTTPS. Additionally, the web server shall have SHA-2 certificate support.
 - 3. Advanced Security: The ability to setup Operator access to the system to be location-dependent. This type of operator access lets one to assign privileges to an operator only at locations in the system where he needs them. For example, you could assign an operator mechanic privileges in one building in a system, view-only privileges in another building, and no privileges in a third building. In addition, this feature provides support for 21 CFR Part 11. With this feature enabled, the

WebCTRL® application can require an operator to record a reason for changing an equipment property before it accepts the change. The WebCTRL® Audit Log report then displays the operator's name and the recorded reason for making the change.

- 4. Trend Export: The Trend Export add-on allows the operator to specify, manage, and export:
 - a. trend source data to .csv files
 - b. trend source data into zipped folders of multiple .csv files
 - c. trend source data into an external database
 - d. Operator can export the files on-demand at any time or at scheduled intervals allowing you to process or analyze trend data outside of your building automation system.
- 5. Operator Interface. The web server shall reside on a high-speed network with the building controllers. Web pages generated by this server shall be compatible with the latest versions of Microsoft Internet Explorer or Edge, Google Chrome, Mozilla Firefox, and Apple Safari browsers. Any of these supported browsers connected to the server shall be able to access all system information. Mobile devices shall be recognized by the web server and shall supply the appropriate system content as needed. The Operator Interface (web server with client devices) shall conform to the BACnet Operator Workstation (B-OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L. This includes the ability to configure and/or reconfigure the system from the client device (change programs, graphics, labels, etc.).
- 6. Communication. Web server and controllers shall communicate using BACnet protocol. Web server and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J. Communication between the web server and client (workstation) shall be HTTP or HTTPS protocol utilizing HTML5 language. Use of Adobe Flash in any part of the communication infrastructure is not acceptable.
- 7. Database. System shall support any JDBC (Java DataBase Connectivity) compliant engine. This includes MS SQL, My SQL, PostgreSQL and Oracle.
- 8. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Minimum graphics resolution shall be 1920 x1080 for display of detailed system graphics.
 - b. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-andclick navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - c. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
 - d. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - e. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in) or shall only require widely available no-cost plug-ins (such as Active-X or Adobe Flash).
- 9. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system to create and modify graphics that are saved in the same formats as are used for system graphics.
- 10. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.
- 11. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand- alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If

furnished as a stand- alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

- Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
- b. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
- c. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password.
- d. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
- e. Video Training. Provide on-line video support to supplement on-line help assistance. Video content shall be relevant and support existing system documentation.
- f. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data.
 - Operator Access. The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users. System Administrators shall also be able to vary and deny each operator's privileges based on the geographic location, such as the ability to edit operating parameters in Building A, to view but not edit parameters in Building B, and to not even see equipment in Building C.
 - 2) Password Policy Rules. System administrator shall invoke policies for minimum password strength, including number of characters, special characters and numbers, upper and lower case, etc.
 - 3) Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
 - 4) Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
- g. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator
- h. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Sequences of Operation. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
- i. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms or mnemonics.
- j. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send SMS text, and audibly annunciate.
- k. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms and archive closed alarms to the workstation or web server hard drive.
- 1. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as

specified in Sequences of Operation or in project points listing. Trends shall be BACnet trend objects. As a minimum, all physical points in the system shall be trended within the local controller (AAC, ASC, BC) for at least 277 samples per point. Selected points, as desired, shall be available for historical archiving within the server. The historical archiving capability cannot be less than 2 years.

- m. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
- n. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
- o. Audit and Security Detail. All users accessing the system shall have their actions recorded. Information recorded shall include login/logout time and date; system modifications with before and after values; ability to report user activity based on individual and/or date and time.
- p. Standard Reports. Furnish the following standard system reports:
- q. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
- r. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
- s. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - 1) Alarm History.
 - 2) Trend Data. Operator shall be able to select trends to be logged.
- t. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
- u. Time Lapse Graphic Replay. Operator shall be able to "replay" any graphic in the system to see how key values changed over an operator-selected period of time. Operator shall be able to select the starting date/time for this display and the end date/time or the display period. System shall then display the graphic as it would have looked at the beginning of that period, displaying key data, dynamic colors, etc. based upon values recorded at the start time. When the operator starts the replay the graphics and key values shall dynamically change to produce the effect of "fast forwarding" through the designated period of time. Once the system has been operational for at least 30 days, the contractor shall demonstrate that up to 24 hours of data from within the last 30 days can be replayed on any graphic page. Owner's representative shall choose the graphic pages for this demonstration at the time of the demonstration.

v.

3.6 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Calibration Requirements
 - 1. Calibrating and adjusting.
 - a. Calibrate instruments.
 - b. Make three-point calibration test for both linearity and accuracy for each analog instrument.

- c. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
- d. Control system inputs and outputs:
 - 1) Check analog inputs at 0, 50, and 100 percent of span.
 - 2) Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - 3) Check digital inputs using jumper wire.
 - 4) Check digital outputs using ohmmeter to test for contact making or breaking.
 - 5) Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

e. Flow:

- 1) Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
- 2) Manually operate flow switches to verify that they make or break contact.

f. Pressure:

- 1) Calibrate pressure transmitters at 0, 50, and 100 percent of span.
- Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

g. Temperature:

- 1) Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
- 2) Calibrate temperature switches to make or break contacts.
- h. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
- i. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
- j. Provide diagnostic and test instruments for calibration and adjustment of system.
 - 1) Provide one calibration kit including clean air calibration glass bottle for zero calibration and specific refrigeration calibration gas for span calibration, minimum 58-L capacity, pressure regulator, and tubing.
- k. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures for review and approval before initiating startup procedures, per the Commissioning Plan.
- 2. Adjust initial pressure, temperature and humidity set points.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.

- 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
- 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
- 6. Test each system for compliance with sequence of operation.
- 7. Test software and hardware interlocks.

D. DDC Verification:

- 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
- 2. Check instruments for proper location and accessibility.
- 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
- 4. Check instrument tubing for proper fittings, slope, material, and support.
- 5. Check installation of air supply for each instrument.
- 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
- 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
- 8. Check temperature instruments and material and length of sensing elements.
- 9. Check control valves. Verify that they are in correct direction.
- 10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
- 11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- E. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.7 ADJUSTING:

- A. This Contractor shall work with the Balancing Contractor to provide verification of CFM reading from each DDC terminal unit.
- B. Calibrating and Adjusting:
 - 1. Calibrate instruments.
 - 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 - 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 - 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

- a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
- b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

- a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
- b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

- a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
- b. Calibrate temperature switches to make or break contacts.
- 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
- 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
- 10. Provide diagnostic and test instruments for calibration and adjustment of system.
- 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- C. Adjust initial temperature and humidity set points.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.
- E. Verify proper operation of every control point in the presence of the Engineer. Include point-by-point checkout.
- F. After DDC controls are operating correctly, autotuning shall be turned off."
- G. The control manufacturer shall provide a period of free service extending through one complete heating season and one complete cooling season, after acceptance of the control system, and shall report the condition of the control equipment to the Owner and the Architect.



KCTCS Building Automation Systems Implementation Guide for Tridium Niagara Web Supervisor Integration

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- 7. Integration to College Supervisor
- 8. Close-out Procedures and Record Documentation

Revision History

 April 26, 2019
 Rev 4.0 - 2019 updates
 KCTCS/MSI

 June 5, 2019
 Rev 4.1 - 2019 updates
 KCTCS

Complete revision history available on Master Doc. V 3.0.



1. Introduction

A. Background

- 1. For several years, KCTCS facilities have been standardized on the Tridium Niagara platform. This platform is well-suited for the integration of the wide spectrum of controls and providers that KCTCS uses for its existing facilities and new construction projects. KCTCS recently invested in a new model to streamline the building automation system access throughout the network of its sixteen (16) colleges and the system office located in Versailles. All building-level JACEs will feed into a college server supervisor. Subsequently all college server supervisors will feed into a single Master Web Supervisor for the system.
- 2. This new model was developed by Paladin, Inc., a commissioning and engineering firm based in Lexington, KY and Cochrane Supply and Engineering, a Tridium distribution company with experience in implementing enterprise-level systems. The process of adapting this new model includes a transitional period during which existing college servers will be moved to off-site virtual storage space and building automation systems lacking integration into the college servers will be added.

B. KCTCS BAS Implementation Guide Objectives

- The function of this document is to serve as a guide for controls suppliers and service
 providers in the installation of the new KCTCS building automation features for existing
 facilities and new construction projects. This guide describes all elements of the new
 controls models including:
 - a. Owner Furnished Resources_KCTCS Standard Objects
 - b. Coordination of IP addressing
 - c. Access to the KCTCS network
 - d. Integration to the college server
 - e. Close-out procedures and documentation
- 2. This guide is intended to complement the KCTCS controls supplier training program and the controls supplier's knowledge of Tridium programming. A KCTCS Standards Implementation Checklist is attached for controls suppliers and service providers to reference. As KCTCS's building inventory grows and software is periodically updated, those changes may necessitate future revisions and updates to this BAS Implementation Guide. Where a service, activity, or coordination process is unclear, users of this guide can contact the BAS Standards and Compliance team (listed in Section 1.3 Contacts). Industry best practices should be applied during all BAS work.

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C. Contacts

| KCTCS BAS Standards and Compliance Team | | |
|---|-----------|---------------------------------------|
| KCTCS Facilities Director | Ken Marks | 859 256 3594 |
| KCTCS Facilities BAS Contact | Dick Mink | (859) 256-3220 Dick.mink@kctcs.edu |
| KCTCS Technology Solutions Contact | | |
| College IT Contact | T. | |

D. Overview of Installation Process

- New Construction: The following is an outline of the general process for the implementation
 of the new BAS model for New Construction:
 - a. Bid Award
 - b. Pre-submittal Controls Coordination Meeting
 - c. Submittal Review and JACE Order Coordination
 - d. Pre-installation Controls Coordination Meeting
 - e. Installation
 - f. Completion and Compliance Review
 - g. Integration to College Supervisor
 - h. Owner Training
 - i. Warranty Period
 - j. Turnover to Service Provider
- Existing Facilities: The following is an outline of the general process for the implementation of the new BAS model for Existing Facilities:
 - a. Initiation of College Upgrades
 - b. Service Provider Proposal and Acceptance
 - c. Installation of Upgrades and Standard Objects
 - d. Completion and Compliance Review
 - e. Integration to College Supervisor

2. Owner Furnished Resources

- A. Virtual Servers
 - At the college and system levels, virtual servers will be established in conjunction with KCTCS Technology Solutions and hosted and managed off-site.
 - The process of implementing the new KCTCS standards and policies for existing facilities will generally coincide with the migration of the college servers to the new hosted space.
 - New construction projects will implement the KCTCS standards and policies regardless of the college virtual status during the transitional phase.

B. JACE

 The JACE controller will be acquired by KCTCS through their service provider and be turned over to the controls supplier. The controls contractor should complete a JACE order form and submit it to KCTCS to initiate processing.

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- Typically, the JACE will arrive un-commissioned. The Controls Contractor MAY NOT commission the JACE in a proprietary fashion.
- At the option of KCTCS, the JACE may be delivered with the approved setup and configuration, new KCTCS standard station and KCTCS standard objects pre-loaded.
- The approved hardware devices used for all KCTCS projects will be J-8000 or higher. Sizing and other capacity concerns should be coordinated through the KCTCS Capital Projects Manager.

C. Niagara Software

- 5. College systems were first installed with Niagara 3.8.38. There are some colleges which have been installed at Niagara 4.2.36 and 4.3.58. Therefore, the Controls Vendor is to work with the KCTCS Capital Project Manager or Designated Representative and KCTCS Facilities to determine the appropriate versioning of the software for the specific application.
- 6. The Niagara Software and setup on each JACE/Server shall be standardized to the functional requirements of the new KCTCS Building Automation System Policies. The Autobox Service is a select feature created and demonstrated by Cochrane which has allowed KCTCS to execute the new enterprise model. This service provides a user interface which operates without Java Plug-in and can be viewed on mobile devices. The addition of this service creates fundamental changes in how KCTCS graphics are implemented and delivered.
- 7. Existing buildings will need to be upgraded to a minimum version of Niagara 4.3.58 and have the correct services added to the JACE prior to beginning the standardization process. At no time will the new JACE/Server software be a version ahead of the Master Web Server.

D. Automated Logic Software

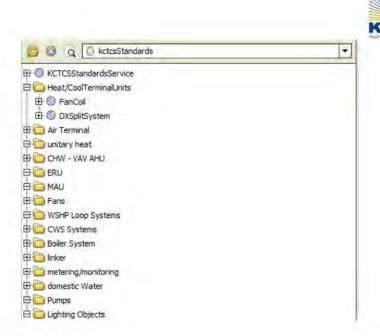
1. ALC software must be version 7.0 and 7.0 compatible.

3. KCTCS Standard Objects

- A. The current version of the KCTCS Standard Objects will be made available for loading on the station delivered to the controls supplier on the Owner Furnished JACE. These standard objects are packaged within the KCTCS Standards Service and are used in a palette. Each type of equipment is reflected in one of the available objects and provides the required points for integration with the College Supervisor and KCTCS Master Web Supervisor. For existing buildings, the current version of the KCTCS Standards Objects will be provided and added to the upgraded JACE. Standard objects will be maintained by the provisioning service from the KCTCS Master Web Supervisor down to the JACEs.
- B. Organization: The organization of the KCTCS Standards Jar file are organized by equipment type. Individual objects are located within folders as depicted in the image below. For example, 'Fan Coil' and 'DX Split System' are types 'Heat/Cool Terminal Units'.

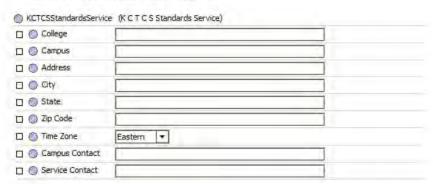
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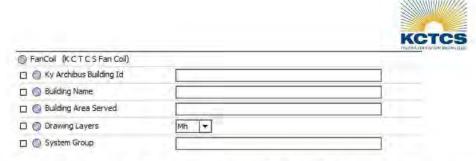
C. Metadata

- The KCTCS Standards Service uses metadata to tag and organize points for integration with the Supervisor, groupings of the histories, user-friendly sort-and-search techniques and distributing the histories to the Commonwealth Energy Management and Controls System (CEMCS) database.
- The Properties View of the Service provides fields that must be completed by the controls supplier for each JACE. (See screenshot)



The Properties View of each object also provides metadata which must be entered. Only the blank fields of the object properties will need to be completed as the other properties will inherit the metadata from the service. (See screenshot)

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4. Most information for these Properties should be available in the project documents. However, items such as the Kentucky Archibus Building ID number may need to be requested from the KCTCS Capital Projects Manager overseeing the new construction. Building area should reflect a floor and/or wing of the building based on the designations selected in the drawings. Existing building standard object metadata should reflect common area names used by the owner. The drawing layer category indicates the discipline under which the equipment falls: (See table)

| М | Mechanical |
|----|---------------------|
| Mh | Mechanical HVAC |
| Мр | Mechanical |
| | Plumbing |
| E | Electrical |
| Ep | Electrical Power |
| El | Electrical Lighting |

- 5. System Group is a field provided to record the primary system connected to the equipment object. The System Group field for a terminal unit would be the name of the its handling unit. The System Group for a pump manager would be the chilled or hot water system it serves.
- D. Standard Object Point Characteristics
 - 1. Points List
 - a. The points programmed into each standard object include the primary operating control
 points and the required points for common configurations of CEMCS integration for that
 device type.
 - b. For that reason, the VAV object points list shown below includes command and status points for a fan and for instances of VAV boxes that are not fan-powered, that slot will remain unused.

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2. Point Properties and Extensions

- a. The points programmed into each standard object are designed to standardize the alarming criteria and trending intervals for all similar devices with KCTCS Standards and Policies.
- b. There are history extensions which are established to save point data at the rate consistent with CEMCS standards for all required points. There are also alarm extensions to govern the 'out of range' alarm source information to align with the approved operating guidelines for KCTCS facilities.

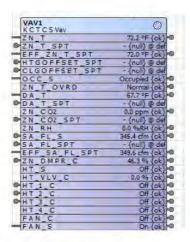
E. Adding and Using Standard Objects (Example VAV Box)

1. New Construction

- a. The standard objects do not replace the work normally performed by the controls suppliers to implement equipment folders, point-to-point connections, logic and sequencing.
- b. The objects are a means of consistently conveying the naming convention used in the KCTCS System and managing history building and alarming functions.

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2. Existing Facilities

- a. The KCTCS Standard Objects can be added and linked to an existing set of points for each piece of connected equipment. Equipment operation remains controlled by the existing logic and programming. However, the point nomenclature, trending intervals, and alarming source information will be updated.
- b. As the Standards Service and Object use large amounts of memory, the JACEs for existing facilities will need to be reviewed for potential upgrades. This requires clean-up after the addition of the standard objects on the wiring diagrams to remove any redundant alarms and history extensions.

3. Device Naming

- Each device should be uniquely named based on the engineer's provisions in the construction documentation.
- Device naming for existing facilities should remain consistent with the existing nomenclature for maintenance and operational personnel's reference.
- c. Certain characters and character lengths may need to be altered for one of two reasons:
 - 1) Equipment names longer than fifteen (15) characters will cause issues with the creation of certain point histories; and
 - 2) Spaces should be replaced by underscores in a consistent naming convention.
- d. When standard objects are added to the wireframe, the initial pop-up request is for the Equipment Tag. For each standard object, enter the equipment name into this field and continue.

F. Historic Data Storage

 The standard time intervals for point trending have been pre-programmed into the standard objects for each device.

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- Linking the correct point with the correct slot on the standard object prepares it for integration with both the college and master web supervisor servers. The set of all linked points still needs to be enabled from the History Service (or on an individual basis at each extension).
- NOTE: Best practice is to fill out all appropriate metadata in the Standard Object before enabling the histories for associated points.

G. Alarms

- The standard parameters for alarming have been pre-programmed into the standard object each device.
- Linking the correct point with the correct slot on the standard object enables notification once the console has been established and readies the device for integration with the college web supervisor alarm console.
- Alarm tuning is a likely exercise that will need to occur once the building is on-line and operators begin receiving alarms.
- Alarm tuning is the responsibility of the controls installing contractor. This includes ensuring
 proper out-of-range alarm limits are configured correctly in Standard Object, along with
 linking corresponding points that have alarm dependencies.

H. Graphics

- Graphics associated with the KCTCS Standard Objects will be hosted and integrated at the college server level. These standard graphics will be developed and maintained by the Capital Project Manager or Designated Representative.
- Graphics associated with Custom Equipment will be developed by the Capital Project Manager or Designated Representative, specific for the application using the Niagara kitPxN4svg tools.
- Graphics for Building and Building Systems level applications will be developed specific for the application by the Capital Project Manager or Designated Representative using the Niagara kitPxN4svg tools. These graphics will be hosted and integrated with the college-level servers.

4. Controls Supplier Coordination

- A. New IP Address and VPN Access Requests
 - With the establishment of a new BAS model, KCTCS Technology Solutions understood the opportunity to improve the security of the KCTCS network by assigning private IP addresses for all JACEs.
 - These private IP addresses will be coordinated with the College IT and KCTCS Technology Solutions departments.
 - To add a JACE to the network or if remote access to the JACE is required, controls suppliers should complete and submit a New IP Address and VPN Access Request Form.

B. New User Requests

- A New User Request Form is completed and submitted by the controls supplier when a new user for the company requires access to the browser site for any KCTCS facility.
- Users will enter through the Master Web Supervisor and have access to the college supervisor and sites as requested.

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3. New User Request forms should be submitted to KCTCS BAS Facility Manager for approval.

C. Transfer of Commissioned JACE

1. Typically, Owner-furnished JACE's will be delivered directly to the controls vendor.

5. Controls Supplier Installation

A. User Service and Security

- The controls supplier should add any relevant user profiles to the JACE for programming and monitoring as required for project.
- It is recommended that those usernames follow the pattern user 'Last Name' plus 'First Initial' (Example: smithr).
- These users should be set to have one of the following standard prototypes: System Operator, System Administrator, Service Operator, Service Administrator, Facilities Operator, Facilities Administrator, Scheduling, or Reporting.

B. KCTCS Standard Objects

- The controls supplier shall complete all fields of the KCTCS Standards Service and the fields for all devices throughout the facility.
- Select the applicable equipment type consistent with the direction on the engineer's points list for each device and place on the wireframe. Link the controls points for the selected device to the correct slot on the object, being cognizant of the points' function as input or output.
- 3. Supply links to all slots indicated as required points on the engineer's points list.

C. Scheduling

- 1. There is no change to how schedules are implemented at the JACE level.
- 2. Schedules will be integrated to the College Level Supervisor and Master Web Supervisor tiers.
- Linkage of schedules to appropriate equipment in the JACE is the responsibility of the installing contractor. The KCTCS Capital Project Manager or Designated Representative will be responsible for integration of schedules to college servers.

D. Backups

- Once integration is complete, the Capital Project Manager or Designated Representative will set up an automatic backup job on the associated college server to back up the JACE weekly. A retention policy of "last 5" will be enforced.
- E. Best Practices

6. Integration to College Supervisor

A. Notification

- For new construction, the controls supplier should notify the KCTCS Capital Project Manager or Designated Representative of their readiness according to the schedule determined during the HVAC Instrumentation and Controls Scheduling Meeting.
- 2. In order for the integration to occur, the following must be satisfied:
 - a. JACE communicating over KPEN
 - b. JACE on secured ports

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- c. JACE credentials delivered to KCTCS BAS Standards and Compliance Team
- d. JACE Toolkit transmitted
- e. All standard objects must be generated and linked to the correct points
- f. All appropriate metadata in Standard Objects are completed and saved.
- g. All histories are enabled from Standard Objects that have point links.
- h. No points other than Standard Object points have histories appended.

Toolkits

- The installing contractor shall be responsible for delivering a complete toolkit, in Microsoft Excel format, to the KCTCS Capital Project Manager or Designated Representative.
- The toolkit shall detail all JACE information, including IP addresses, platform/station ports, platform/station credentials, station name.
- The toolkit shall outline all equipment to be integrated by the KCTCS Capital Project Manager or Designated Representative. All points, Standard Object or custom, shall be outlined for each piece of equipment, and whether histories or alarms are associated with each.
- 4. The toolkit shall outline any desired schedules to be integrated, or created.

B. Compliance Review

- Upon notification, the KCTCS Capital Project Manager or Designated Representative will review the controls supplier's completion of standard object and connections. A JACE Commissioning Report will be generated and provided to the Controls Vendor. Outstanding corrective action will need to be completed prior to integration.
- Once the JACE is deemed ready for integration, the KCTCS Capital Project Manager or Designated Representative will then initiate integration. Compliance and integration is to be performed leaving adequate time for commissioning of controls, substantial completion date, and owner training.

7. Close-out Procedures and Record Documentation

- A. Turnover of Credentials
 - The platform and station access credentials shall be recorded and transferred to the owner at the time of occupancy.
 - At the end of the warranty period on a new construction project, the controls vendor's access will be removed.

B. Record Documentation

- 1. Single-line diagrams
 - Within the as-built documentation, there must be a layout of the equipment which demonstrates primary and secondary device relationships.
 - b. CEMCS requires a schematic or table showing which terminal units are connected to each air handling unit and which pumping, heating and cooling equipment is related to each respective heating or cooling hydronic system.
 - c. This applies to all mechanical, electrical, and plumbing systems that are controlled by the building automation system.

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KCTCS Standards Implementation Checklist

Secure JACE hardware and complete physical connections to local devices and equipment.

JACE Settings

- □ Ensure that the correct Niagara version (AX or 4.X) is running on the JACE
- □ Enable SSL connections and ports per the KCTCS BAS Policy
- Change Platform access from default credentials to meet KCTCS BAS Policy
- Setup the Admin account at the station level per the KCTCS BAS Policy
- Setup the NiagaraUser account at the station level
- Add the current version of KCTCS Standards module to the JACE and drop the KCTCS Standards
 Service in the Services folder
- Setup the Classes and Recipients in Alarm Service per KCTCS BAS Policy
- Add the current version of Email module to the JACE and drop the Email Service in the Services folder
- Set NtpPlatformServiceQnx under Platform Services to sync time with college server
- Set Audit History configuration to 2500 records.
- Add Report Service and generate Downed Device reports for each communication protocol

Create communication drivers and programming per standard practices. Utilize attached "KCTCS Standard Object Toolkit.xls" to document objects, points, histories, and alarms for remaining station setup.

KCTCS Standards Service and Objects

- Open KCTCS Standards Service property sheet and complete all empty fields
- Open the KCTCS Standards module in the Palette
- Open the wire sheet of each piece of equipment on the JACE, add the appropriate Standard Object, name the Object with the appropriate Equipment Tag, and link all applicable points to the correct slot on the Object
- Open the Object's property sheet and complete all empty fields
- Repeat as necessary for all equipment and objects.
- Backup and save the Station, email copy of backup to KCTCS Capital Project Manager or Designated Representative
- FOR EXISTING BUILDINGS: Save the history database under the Actions tab of the History Service, then disable and delete all existing / old histories
- □ Enable histories for all newly linked points, do not enable histories for unlinked points
- Disable all unused alarms for Standard Object points that are unlinked or not used
- FOR EXISTING BUILDINGS: Disable duplicate and nuisance alarms, ensure existing critical alarms are rerouted to be Priority 1 or 2
- Establish communication over Niagara Network with college server (to be coordinated with KCTCS Capital Project Manager or Designated Representative)
- □ Import schedule(s) from college server to JACE and link to appropriate objects

Turnover

- $\hfill \square$ Record JACE IP Address, Station Admin Username and Password
- Transmit the completed "KCTCS Standard Object Toolkit.xls" to the KCTCS Standards & Compliance Team.

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□ FOR NEW CONSTRUCTION: Prepare record single-line diagram of equipment and systems

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Rev 4.0 2019/04/25

END OF SECTION 230900

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Blowdown-drain piping.
 - 6. Air-vent piping.
 - 7. Safety-valve-inlet and -outlet piping.
- B. Install pipe accessories (such as strainers, valves, control valves, sensing wells, hangers, gages, pumps, etc., furnished under other sections of the Specifications, in piping systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Chemical treatment.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
- C. Delegated-Design Submittal:
 - 1. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 2. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control reports.
- D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
 - 2. Condensate-Drain Piping: 150 deg F (66 deg C).
 - 3. Blowdown-Drain Piping: 200 deg F (93 deg C).
 - 4. Air-Vent Piping: 200 deg F (93 deg C).
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Victaulic Company.
 - 2. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
 - 3. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves- Gasket shall be Grade "EHP" EPDM compound designed for temperatures from -30 deg F to +250 deg F. Couplings shall be Victaulic Style 607 and Butterfly Valve Victaulic Style 608. If contractor elects to use stainless steel, Victaulic style 89 Couplings may be utilized in conjunction with Style 461 Butterfly Valve.
- E. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Victaulic Company.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Base of Design: Victaulic Style 107/W07 or engineered approved equal. Gaskets shall be grade "EHP" EDPM designed for operating temperatures from -30 deg F to +250 deg F.
 - a. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Three flexible couplings may be used in lieu of flexible connectors at equipment connections and shall be placed in close proximity to the vibration source. Victaulic Style 177, W77.
 - b. All grooved components must be of one manufacturer.
 - Victaulic Style 730/W730 Strainers are acceptable. Contractor may utilize Victaulic Style 731D Suction Diffuser with grooved end piping system
 - d. Victaulic 300-Series/WVic-300 Butterfly Valve and 716/W716 Check Valve may be used with grooved piping system. Utilization of "Tri-Service" Assembly is acceptable.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 **JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company.
 - c. Central Plastics Company.
 - d. Hart Industries International, Inc.
 - e. Jomar International Ltd.
 - f. Matco-Norca.
 - g. Watts Regulator Co.
 - h. Zurn Industries, LLC.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 150 psig (1035 kPa) < Insert value>.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. Matco-Norca.
- d. Watts Regulator Co.
- e. Zurn Industries, LLC.

2. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 150 psig (1035 kPa).
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elster Perfection.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.

2. Description:

- a. Standard: IAPMO PS 66.
- b. Electroplated steel nipple, complying with ASTM F 1545.
- c. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- d. End Connections: Male threaded or grooved.
- e. Lining: Inert and noncorrosive, propylene.

2.6 BYPASS CHEMICAL FEEDER

- A. Description: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
 - 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be the following:
 - 1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Hot-water heating piping installed belowground and within slabs shall be the following:
 - 1. Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.
- D. Chilled-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be the following:
 - 1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Chilled-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- F. Chilled-water piping installed belowground and within slabs shall be the following:
 - 1. Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.
- G. Makeup-water piping installed aboveground shall be the following:
 - 1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- H. Makeup-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- I. Condensate-Drain Piping: Type M (Type C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

- J. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- K. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 - 2. Outlet: Type K (Type A), annealed-temper copper tubing with soldered or flared joints.
- L. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

- A. Use fittings for all changes in direction and all branch connections in piping. At installer's option, weldolets or thread-o-lets may be used for branch connections to mains as follows:
 - 1. Only in pipe main sizes 2-1/2" and larger.
 - 2. Only when branch pipe size is 1/2 or less of main pipe size.
 - 3. Grooved mechanical coupling tap fittings may be used subject to the above mentioned conditions, only in piping systems where grooved mechanical couplings are permitted.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- M. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- P. Install branch connections to mains usingtee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- Q. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- R. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- S. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
- T. Install shutoff valve immediately upstream of each dielectric fitting.
- U. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- V. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration Controls for HVAC Piping and Equipment".
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.

4. Spring hangers to support vertical runs.

- 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
 - 2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
 - 3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m).
 - 4. NPS 2 (DN 50): Maximum span, 10 feet (3 m).
 - 5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m).
 - 6. NPS 3 (DN 80) and Larger: Maximum span, 12 feet (3.7 m).
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
 - 4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 - 5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 - 6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 - 7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use groovedend fittings and rigid, grooved-end-pipe couplings.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
 - 1. pH: 9.0 to 10.5.
 - 2. "P" Alkalinity: 100 to 500 ppm.
 - 3. Boron: 100 to 200 ppm.
 - 4. Chemical Oxygen Demand: Maximum of 100 ppm. Revise this value if closed system contains glycol.
 - 5. Corrosion Inhibitor:
 - a. Sodium Nitrate: 1000 to 1500 ppm.
 - b. Molybdate: 200 to 300 ppm.
 - c. Chromate: 200 to 300 ppm.
 - d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
 - e. Chromate Plus Molybdate: 50 to 100 ppm each.
 - 6. Soluble Copper: Maximum of 0.20 ppm.
 - 7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum of 10 ppm.
 - 8. Total Suspended Solids: Maximum of 10 ppm.
 - 9. Ammonia: Maximum of 20 ppm.
 - 10. Free Caustic Alkalinity: Maximum of 20 ppm.
 - 11. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maximum of 1000 organisms/mL.
 - b. Total Anaerobic Plate Count: Maximum of 100 organisms/mL.
 - c. Nitrate Reducers: 100 organisms/mL.
 - d. Sulfate Reducers: Maximum of zero organisms/mL.
 - e. Iron Bacteria: Maximum of zero organisms/mL.
- B. Install bypass chemical feeders in each hydronic system where indicated.
 - 1. Install in upright position with top of funnel not more than 48 inches (1200 mm) above the floor.
 - 2. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.

- 3. Install NPS 3/4 (DN 20) pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.
- C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Test systems to the following hydrostatic pressures:

Chilled water
 Hot water
 200 psig
 200 psig

- D. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.
 - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

- 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
- 7. Verify lubrication of motors and bearings.

3.9 CHEMICAL PIPE CLEANING

- A. Procure the services of a qualified water treatment specialist, Vulcan Laboratories, Inc., Mogul, Dearborn, or approved equal, to provide chemicals and supervision for chemically cleaning the heating and air conditioning piping systems.
- B. Perform draining, flushing, refilling and chemical cleaning. Furnish and install piping, fittings, pumps, connections, etc., required by treatment specialist to conduct cleaning operations. The treatment specialist shall supervise cleaning, provide chemicals and shall provide a certificate of completion of cleaning procedures for each piping system. Send certificates to Architect/Engineer before final inspection is made.
- C. Chemically clean the following piping systems:
 - 1. Chilled water system
 - 2. Hot water heating system
- D. Perform cleaning in accordance with treatment specialist's procedures. Drain system completely and refill with clean water with no chemicals after chemical cleaning is complete.
- E. Submit name and qualifications of water treatment specialist to the Architect/Engineer for evaluation and approval. Also, submit proposed cleaning procedures for each piping system and type of chemicals to be used.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Blowdown-drain piping.
 - 6. Air-vent piping.
 - 7. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
 - 2. Condensate-Drain Piping: 150 deg F (66 deg C).
 - 3. Blowdown-Drain Piping: 200 deg F (93 deg C).
 - 4. Air-Vent Piping: 200 deg F (93 deg C).
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping." Section 15112 "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."Section 15900 "HVAC Instrumentation and Controls."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Nexus Valve, Inc.
 - g. Taco.
 - h. Tour & Andersson; available through Victaulic Company.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig (860 kPa).
 - 10. Maximum Operating Temperature: 250 deg F (121 deg C).
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company.
- 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
- 3. Ball: Brass or stainless steel.
- 4. Stem Seals: EPDM O-rings.
- 5. Disc: Glass and carbon-filled PTFE.
- 6. Seat: PTFE.
- 7. End Connections: Flanged or grooved.
- 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
- 9. Handle Style: Lever, with memory stop to retain set position.
- 10. CWP Rating: Minimum 125 psig (860 kPa).
- 11. Maximum Operating Temperature: 250 deg F (121 deg C).
- E. Combination Balancing And Shutoff Valves:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Type CB
 - b. Bell and Gossett Circuit Setter
 - c. Tour & Andersson
 - 2. Provide screwed ends on valves 2 inches (DN50) and smaller and flanged ends of valves 2-l/2 inches (DN65) and larger. Valves shall be complete with calibrated dial, adjustable memory and two pressure taps on side of body; one upstream and one downstream. Provide each tap with check valve and drip cap for use with portable water meter. Manufacturer shall provide flow charts for use in setting valve flows.
 - 3. Working pressure for valves shall be 400 psi minimum at 250°F. Provide valves with bolting arrangement suitable for ASA 150 pound flanges.

Use above paragraph for chilled water systems on uk campus. Use paragraph below for other projects.

- 4. Working pressure for valves shall be 200 psi minimum at 250°F. Provide valves with bolting arrangement suitable for ASA 125 pound flanges.
- 5. Operators shall be complete with position indicator, adjustable memory stop, and hand wheels.
- F. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Burling Valve, The Regulator Company.
 - e. Conbraco Industries, Inc.
 - f. Spence Engineering Company, Inc.

- g. Watts Regulator Co.
- 2. Body: Bronze or brass.
- 3. Disc: Glass and carbon-filled PTFE.
- 4. Seat: Brass.
- 5. Stem Seals: EPDM O-rings.
- 6. Diaphragm: EPT.
- 7. Low inlet-pressure check valve.
- 8. Inlet Strainer: Removable without system shutdown.
- 9. Valve Seat and Stem: Noncorrosive.
- 10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- G. Diaphragm-Operated Safety Valves: ASME labeled.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.
 - 2. Body: Bronze or brass.
 - 3. Disc: Glass and carbon-filled PTFE.
 - 4. Seat: Brass.
 - 5. Stem Seals: EPDM O-rings.
 - 6. Diaphragm: EPT.
 - 7. Wetted, Internal Work Parts: Brass and rubber.
 - 8. Inlet Strainer: Removable without system shutdown.
 - 9. Valve Seat and Stem: Noncorrosive.
 - 10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
- 2. Body: Bronze.
- 3. Internal Parts: Nonferrous.
- 4. Operator: Screwdriver or thumbscrew.
- 5. Inlet Connection: NPS 1/2 (DN 15).

- 6. Discharge Connection: NPS 1/8 (DN 6).
- 7. CWP Rating: 150 psig (1035 kPa).
- 8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vents:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
- 2. Body: Bronze or cast iron.
- 3. Internal Parts: Nonferrous.
- 4. Operator: Noncorrosive metal float.
- 5. Inlet Connection: NPS 1/2 (DN 15).
- 6. Discharge Connection: NPS 1/4 (DN 8).
- 7. CWP Rating: 150 psig (1035 kPa).
- 8. Maximum Operating Temperature: 240 deg F (116 deg C).

C. Expansion Tanks:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
- 2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- 3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
- 4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
- 5. Gage Glass: Full height with dual manual shutoff valves, [3/4-inch- (20-mm-)] <Insert dimension> diameter gage glass, and slotted-metal glass guard.

D. Bladder-Type Expansion Tanks:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.

- d. Taco, Inc.
- 2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- 3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
- 4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Tangential-Type Air Separators:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
- 2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
- 3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
- 4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
- 5. Blowdown Connection: Threaded.
- 6. Size: Match system flow capacity.

2.4 MISCELLANEOUS DEVICES

- A. Chilled water surge tank shall be all welded steel construction, ASME tested and stamped for 125 psig working pressure. Tank interior shall be phenolic or epoxy lined. Tank shall be complete with stand for vertical mounting, Il" x 15" manhole and supply and return connections as shown on the Drawings.
- B. Pump Suction Diffusers: cast-iron body, with threaded connections for 2 inch and smaller, flanged or grooved connections for 1-1/2 inch and larger; 175 psig working pressure, 240 deg.F. maximum operating temperature; and complete with the following features:
 - 1. Inlet vanes with length 2-1/2 times pump suction diameter or greater.
 - 2. Cylinder strainer with 3/16 inch diameter openings with total free area equal to or greater than 5 times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head.
 - 3. Disposable fine mesh strainer to fit over cylinder strainer.
 - 4. Permanent magnet, located in flow stream, removable for cleaning.
 - 5. Adjustable foot support, designed to carry weight of suction piping.
 - 6. Blowdown tapping in bottom; gage tapping in side.

2.5 CHEMICAL TREATMENT

- A. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
 - 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.6 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

- 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
- 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
- 3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
- 4. CWP Rating: 125 psig (860 kPa).

B. Stainless-Steel Bellow, Flexible Connectors:

- 1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
- 2. End Connections: Threaded or flanged to match equipment connected.
- 3. Performance: Capable of 3/4-inch (20-mm) misalignment.
- 4. CWP Rating: 150 psig (1035 kPa).
- 5. Maximum Operating Temperature: 250 deg F (121 deg C).

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Do not install iron or steel valves in copper piping systems. Use bronze valves.
- B. Install combination balancing and shutoff valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- C. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- D. Install calibrated-orifice, balancing valves at each branch connection to return main.
- E. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- F. Install check valves at each pump discharge and elsewhere as required to control flow direction. Check valves on pump discharges shall be the silent type.
- G. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- H. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.
- F. Field charge expansion tanks to the required air pressure. Required air pressure is the same as the system pressure reducing valve delivery pressure.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Close-coupled, in-line centrifugal pumps.
 - 2. Close-coupled, end-suction centrifugal pumps.

1.3 **DEFINITIONS**

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Armstrong Pumps, Inc.</u>
 - 2. <u>ITT Corporation</u>.
 - 3. <u>TACO Incorporated.</u>
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump Construction:
 - 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet and threaded companion-flange connections.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 - 3. Pump Shaft: Stainless steel.
 - 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
 - 5. Pump Bearings: Permanently lubricated ball bearings.
- D. Motor: Single speed and rigidly mounted to pump casing.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Open, dripproof.
 - b. Enclosure Materials: Cast iron.
 - c. Motor Bearings: Permanently lubricated ball bearings.
 - d. Efficiency: Premium efficient.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Armstrong Pumps, Inc.
 - 2. <u>ITT Corporation</u>.
 - 3. PACO Pumps; Grundfos Pumps Corporation, USA.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:

- 1. Casing: Radially split, cast iron, with drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
- 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
- 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
- 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
- 5. Pump Bearings: Permanently lubricated ball bearings.
- D. Motor: Single speed and rigidly mounted to pump casing with integral pump support.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Open, dripproof.
 - b. Enclosure Materials: Cast iron.
 - c. Motor Bearings: Permanently lubricated ball bearings.
 - d. Unusual Service Conditions:
 - e. Efficiency: Premium efficient.

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

- 1. Angle pattern.
- 2. 175-psig (1204-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting.
- 3. Bronze startup and bronze or stainless-steel permanent strainers.
- 4. Bronze or stainless-steel straightening vanes.
- 5. Drain plug.
- 6. Factory-fabricated support.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Equipment Mounting:
 - 1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in contract documents.
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration Controls for HVAC."
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.
 - Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration Controls for HVAC."
 - 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section "Hydronic Piping" and Section "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check, shutoff, and throttling valves on discharge side of pumps.
- F. Install Y-type strainer, suction diffuser (without strainer), and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

- 1. Complete installation and startup checks according to manufacturer's written instructions.
- 2. Check piping connections for tightness.
- 3. Clean strainers on suction piping.
- 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
- 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- 6. Start motor.
- 7. Open discharge valve slowly.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 2123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves and specialties.
 - 3. Refrigerants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
 - 1. Include pressure drop, based on manufacturer's test data, for the following:
 - Filter dryers.
 - b. Strainers.
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For refrigerants.
- C. Shop Drawings:
 - 1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
 - 2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
 - 3. Show interface and spatial relationships between piping and equipment.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

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1.6 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 - 4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.

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- b. Heldon Products; Henry Technologies.
- c. Parker Hannifin Corp.
- d. Paul Mueller Company.
- 2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
- 3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
- 4. Operator: Rising stem and hand wheel.
- 5. Seat: Nylon.
- 6. End Connections: Socket, union, or flanged.
- 7. Working Pressure Rating: 500 psig (3450 kPa).
- 8. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
 - d. Paul Mueller Company.
- 2. Body and Bonnet: Forged brass or cast bronze.
- 3. Packing: Molded stem, back seating, and replaceable under pressure.
- 4. Operator: Rising stem.
- 5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
- 6. Seal Cap: Forged-brass or valox hex cap.
- 7. End Connections: Socket, union, threaded, or flanged.
- 8. Working Pressure Rating: 500 psig (3450 kPa).
- 9. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 - e. Paul Mueller Company.
- 2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
- 3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
- 4. Piston: Removable polytetrafluoroethylene seat.
- 5. Closing Spring: Stainless steel.
- 6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
- 7. End Connections: Socket, union, threaded, or flanged.
- 8. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
- 9. Working Pressure Rating: 500 psig (3450 kPa).
- 10. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 - e. Paul Mueller Company.
 - f. Refrigeration Sales, Inc.
- 2. Body: Forged brass with brass cap including key end to remove core.
- 3. Core: Removable ball-type check valve with stainless-steel spring.
- 4. Seat: Polytetrafluoroethylene.
- 5. End Connections: Copper spring.
- 6. Working Pressure Rating: 500 psig (3450 kPa).

E. Straight-Type Strainers:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
- 2. Body: Welded steel with corrosion-resistant coating.
- 3. Screen: 100-mesh stainless steel.
- 4. End Connections: Socket or flare.
- 5. Working Pressure Rating: 500 psig (3450 kPa).
- 6. Maximum Operating Temperature: 275 deg F (135 deg C).

F. Angle-Type Strainers:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.
 - b. Heldon Products; Henry Technologies.
 - c. Parker Hannifin Corp.
- 2. Body: Forged brass or cast bronze.
- 3. Drain Plug: Brass hex plug.
- 4. Screen: 100-mesh monel.
- 5. End Connections: Socket or flare.
- 6. Working Pressure Rating: 500 psig (3450 kPa).
- 7. Maximum Operating Temperature: 275 deg F (135 deg C).

G. Moisture/Liquid Indicators:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.

- d. Parker Hannifin Corp.
- 2. Body: Forged brass.
- 3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
- 4. Indicator: Color coded to show moisture content in parts per million (ppm).
- 5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
- 6. End Connections: Socket or flare.
- 7. Working Pressure Rating: 500 psig (3450 kPa).
- 8. Maximum Operating Temperature: 240 deg F (116 deg C).
- H. Replaceable-Core Filter Dryers: Comply with AHRI 730.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 - 2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 - 3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 - 4. Desiccant Media: Activated alumina.
 - 5. Designed for reverse flow (for heat-pump applications).
 - 6. End Connections: Socket.
 - Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 - 8. Maximum Pressure Loss: 2 psig (14 kPa).
 - 9. Working Pressure Rating: 500 psig (3450 kPa).
 - 10. Maximum Operating Temperature: 240 deg F (116 deg C).
- I. Permanent Filter Dryers: Comply with AHRI 730.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Danfoss Inc.
 - b. Emerson Climate Technologies.
 - c. Heldon Products; Henry Technologies.
 - d. Parker Hannifin Corp.
 - 2. Body and Cover: Painted-steel shell.
 - 3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 - 4. Desiccant Media: Activated alumina.
 - 5. Designed for reverse flow (for heat-pump applications).
 - 6. End Connections: Socket.
 - Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 - 8. Maximum Pressure Loss: 2 psig (14 kPa).
 - 9. Working Pressure Rating: 500 psig (3450 kPa).
 - 10. Maximum Operating Temperature: 240 deg F (116 deg C).

2.4 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Arkema Inc.
 - b. DuPont Fluorochemicals Div.
 - c. Genetron Refrigerants; Honeywell International Inc.
 - d. Mexichem Fluor Inc.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 4 (DN 100) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service
 areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to contract documents for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in contract documents if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to contract documents.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in contract documents.
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in contract documents.
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in contract documents.

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.

- 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
- 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
- 4. Spring hangers to support vertical runs.
- 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod, 1/4 inch (6.4 mm).
 - 4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 - 5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 - 6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 - 7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod, 3/8 inch (9.5 mm).
 - 8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod, 3/8 inch (9.5 mm).
 - 9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod, 1/2 inch (13 mm).
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Verify that compressor oil level is correct.
 - 2. Open compressor suction and discharge valves.
 - 3. Open refrigerant valves except bypass valves that are used for other purposes.
 - 4. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
- 2. Double-wall rectangular ducts and fittings.
- 3. Single-wall round ducts and fittings.
- 4. Double-wall round ducts and fittings.
- 5. Sheet metal materials.
- 6. Sealants and gaskets.
- 7. Hangers and supports.
- B. Install duct accessories (such as turning vanes, access doors, dampers, automatic control dampers, sound traps, grilles and diffusers, etc.) furnished under other sections of the Specification in duct system.

C. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
- 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Adhesives.
 - 2. Sealants and gaskets.

B. Shop Drawings:

- 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
- 2. Factory- and shop-fabricated ducts and fittings.
- 3. Fittings.
- 4. Reinforcement and spacing.
- 5. Seam and joint construction.
- 6. Penetrations through fire-rated and other partitions.
- 7. Equipment installation based on equipment being used on Project.
- 8. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

9. Hangers and supports, including methods for duct and building attachment and vibration isolation.

- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Provide round duct and fittings by the same manufacturer.
- B. Comply with the Kentucky Building Code.
- C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
 - 2.
 - 3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment," and Section 7 "Construction and System Startup."

- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches (914 mm), select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches (914 mm) or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. MKT Metal Manufacturing.
 - 2. McGill AirFlow LLC.
 - 3. SHAPE Manufacturing Inc.
 - 4. Sheet Metal Connectors, Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

- 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- 2. For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches (914 mm), select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches (914 mm) or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
 - 3. Where specified for specific applications, all joints shall be welded.
- E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
 - 1. Where specified for specific applications, all joints shall be welded.
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: [0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K)] at 75 deg F (24 deg C) mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534/C 534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.
- H. Double-Wall Duct Interstitial Insulation Thickness:
 - 1. Supply Air Ducts: 1-1/2 inches (38 mm) thick.
 - 2. Return Air Ducts: 1-1/2 inches (38 mm) thick.
 - 3. Exhaust Air Ducts: 1-1/2 inches (38 mm) thick.
- I. Inner Duct: Minimum 24-gauge (0.7-mm) solid galvanized sheet steel.

2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

- 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- 2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eastern Sheet Metal
 - b. Lindab, Inc.
 - c. McGill AirFlow LLC.
 - d. SEMCO LLC.
 - e. Sheet Metal Connectors, Inc.
 - f. Spiral Manufacturing Co., Inc.
 - 2. Provide round duct and fittings by the same manufacturer.
- C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 (1524) Inches (mm) in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- F. There shall be no deformation of fitting shape because of branch takeoff connections.
- G. Do not use duct sealant on fittings.
- H. Coat welded joints with a protective paint, inside and out.
- I. Diverging Flow Fittings: Fabricate with a smooth entrance to branch taps with no excess material projecting from body into branch tap entrance, and no material from branch tap projecting into main body. Use metal thicknesses specified for longitudinal-seam straight ducts.
 - 1. Use factory fabricated fittings for branch takeoffs. Do not use duct/tap (saddle tap) assemblies except where specifically shown on the Drawings.
 - 2. Do not use straight tees in medium or high pressure ductwork. Do not use conical tees in medium or high pressure ductwork unless specifically shown otherwise on the Drawings.
 - 3. Combination (heeled) tees may be used in place of 45 degree elbow and straight lateral combinations if the following criteria is met:

- a. Pressure drop through the heeled tee does not exceed pressure drop through straight lateral and 45 degree elbow combination.
- b. Branch duct depth is at least 2 inches less than main duct depth.
- J. Elbows: Fabricate in die-formed, or gored construction depending on size. Where size indicates gored construction, provide minimum number of gores according to the following table:

| 1. Elbow | | Number | | |
|----------|--------|----------|--|--|
| 2. | Angle | Of Gores | | |
| 3. | 0-35° | 2 | | |
| 4. | 36-71° | 3 | | |
| 5. | 72-90° | 5 | | |

- 6. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter unless specifically shown otherwise on the Drawings. Unless elbow construction type is indicated, fabricate elbows as follows:
- 7. Use adjustable and pleated elbows only in ductwork with pressure classifications of 3 inches or less. Do not use in medium or high pressure ductwork.
- 8. 90-Degree, Two-Piece, Mitered Elbows: Use only where specifically shown on the Drawings. Fabricate with single-thickness turning vanes.

2.5 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. Eastern Sheet Metal
 - b. Lindab, Inc.
 - c. McGill AirFlow LLC.
 - d. SEMCO LLC.
 - e. Sheet Metal Connectors, Inc.
 - 2. Provide round duct and fittings by the same manufacturer.
- B. Inner Duct: Minimum 24-gauge (0.7-mm) solid galvanized sheet steel.
- C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- D. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534/C 534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.
- E. Double-Wall Duct Interstitial Insulation Thickness:
 - 1. Supply Air Ducts: 1-1/2 inches (38 mm) thick.
 - 2. Return Air Ducts: 1-1/2 inches (38 mm) thick.

3. Exhaust Air Ducts: 1 inch (25 mm) 2 inches (51 mm) thick.

2.6 FLEXIBLE DUCTS:

- A. Flexible ducts shall be a factory-fabricated assembly consisting of an all-aluminum flexible duct, insulation and an outer moisture barrier.
- B. Ducts shall be of single-ply aluminum, closely corrugated for strength, folded flat, and knurled to insure air-tightness.
- C. A 1-1/2" thick insulating blanket of glass wool, with a minimum R-Value of 6.0, with a polyethylene moisture barrier shall encase the ducts.
- D. Assembly shall have a flame spread of not over 25, a smoke developed rate of not over 50 and shall comply with U.L. Standard No. UL 181.
- E. Ducts shall be rated for use at 8 inches minimum W.G. positive and negative static pressures for all duct diameters.
- F. Flexible duct shall be secured to the rigid duct and appliance with a nylon adjustable, self-locking, strap and a minimum of three sheet metal screws. The flexible duct shall be sealed airtight at each connection with self-adhesive aluminum tape. Fiber or cloth duct tape is not permitted to seal rigid or flexible duct.
- G. Maximum length of flexible duct shall be 4'0"
- H. Minimum bend radius shall 1.5 times the duct diameter and total offset in any run shall not exceed 90 degrees.
- I. Provide a minimum of one hanger of each run of flexible duct. The hanger must be strapped around the flexible duct and secured to the structure above. Hangers shall not be attached to other mechanical or electrical objects. Hangers may be attached to an approved trapeze. Ceiling grid shall not be used to fabricate a trapeze. Support hangers shall be installed horizontal.
- J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ATCO
 - 2. Clevepak Corporation, Clevaflex Division
 - 3. Flexmaster, USA, Inc.
 - 4. Hart & Cooley, Inc.

2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch- (6-mm-) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch- (10-mm-) minimum diameter for lengths longer than 36 inches (900 mm).

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches (76 mm).
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10 inch wg (2500 Pa), positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
 - Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10 inch wg (2500 Pa), positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Base: Synthetic rubber resin.
 - 3. Solvent: Toluene and heptane.
 - 4. Solids Content: Minimum 60 percent.
 - 5. Shore A Hardness: Minimum 60.
 - 6. Water resistant.
 - 7. Mold and mildew resistant.
 - 8. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.

9. Service: Indoor or outdoor.

- Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Construct ducts according to the "DUCT SEALING, TESTING AND LEAKAGE TABLES" at the end of this specification section.
- B. Ducts shall be galvanized steel except as follows:
 - 1. Range Hood Exhaust Ducts: Comply with (Kentucky Building Code)(NFPA 96).
 - a. Concealed: Carbon-steel sheet.
 - b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
 - c. Continuously weld seams and joints. Comply with (NFPA 96) (Kentucky Building Code).

2. Dishwasher Hood Exhaust Ducts:

- a. Type 304, stainless steel with finish to match kitchen equipment and range hood. Weld and flange seams and joints.
- b. Aluminum, with seams and laps arranged on top of duct.
- c. Continuously weld seams and joints.

3.2 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" unless otherwise indicated.
- C. Do not apply duct sealant to interior surfaces of ductwork.
- D. Do not install mitered elbows of any angle in rectangular ductwork except at points specifically shown on the Drawings. Use smooth radius elbows.
- E. Do not install mitered elbows, (with or without turning vanes) in return or exhaust duct systems except where specifically shown on the Drawings. Use 90° mitered elbows with turning vanes only in low pressure supply air ductwork.
- F. Where radius elbows with R/D ratio of 1.5 cannot be installed due to space limitations, use a radius elbow with an R/D of 1.0.
- G. Do not substitute a square elbow with turning vanes for a radius elbow.
- H. Where square elbows with turning vanes (in supply ductwork) are shown on the Drawings, use square elbows with turning vanes. Do not substitute a radius elbow for a square elbow with turning vanes.
- I. Where square elbows with turning vanes are shown on the Drawings in return or exhaust ductwork, provide minimum size 12"x12" access doors in bottom of elbows, upstream and downstream of turning vanes, for access to clean vanes.
- J. Where radius elbows with R/D ratios of other than 1.5 are shown on the Drawings, install radius elbows with the R/D ratio indicated on the Drawings.
- K. Install ducts in maximum practical lengths with fewest possible joints.
- L. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- M. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- N. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- O. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- P. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

- Q. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- R. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- S. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- T. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation
- U. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.
- V. Branch Connections: Use lateral or conical branch connections.

3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

- A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.
- B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- C. All ducts exposed to view shall be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view shall be carbon steel as per "Duct Schedule" Article.
- D. All joints shall be welded and shall be telescoping, bell, or flange joint as per NFPA 96.

- E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 (3.7) feet (m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.
- F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS

- A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.
- B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch (25-mm)trapped copper drain from each drain pocket to open site floor drain.
- C. Minimize number of transverse seams.
- D. Do not locate longitudinal seams on bottom of duct.
- E. Continuously weld joints and seams. Arrange ductwork so that longitudinal joint is not at bottom of duct. Pitch ductwork down toward dishwasher. Provide drains at low points.

3.6 FLEXIBLE DUCTS, INSTALLATION REQUIREMENTS

- A. For any duct run using flexible ductwork, do not exceed 3'-0" extended length unless shown otherwise on the drawings.
- B. Minimum bend radius shall be 1-1/2 times the duct diameter.
- C. Flexible duct shall not have more than 90 deg. total deflection unless shown otherwise.

3.7 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to be welded. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
- C. Double Wall:
 - 1. Ductwork shall comply with requirements in "Double-Wall Rectangular Ducts and Fittings" or "Double-Wall RoundDucts and Fittings" Article.
 - 2. Ductwork outer wall shall be Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
 - 3. Provide interstitial insulation.

3.8 DUCT SEALING

- A. Seal ducts according to the "DUCT SEALING, TESTING AND LEAKAGE TABLES" at the end of this specification section.
- B. In round and oval ductwork with pressure classifications greater than 3 inches, apply duct sealant continuously over male end of slip joints before assembly. Wipe away any excess sealant protruding inside duct after assembly. Then fasten joint with sheet metal screws and coat entire joint, including screws, with sealant.
 - 1. At Installer's option, the "hardcast" tape and sealant system may be used to seal duct joints instead of the method specified in the paragraph above.
- C. Seal corners of rectangular ductwork completely with sealant, especially corners of "Ductmate" and other types of flanged joints. If holes at corners are too large to permit sealant, then remake joint.
- D. Seal top joints of rectangular ductwork. If ductwork is to be installed too close to building substrate to permit sealing these joints after installation, then seal joints before ductwork is raised into place.
- E. Do not apply duct sealant to interior surfaces of ductwork.
- F. Seal ducts before external insulation is applied.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1220 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- G. Do not use metal decking for suspension of ductwork and accessories. Hang items from top member of joist or provide additional structure to span between top members if needed.

3.10 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
- C. Make connections to grilles, registers and diffusers as detailed on the Drawings. Do not deviate from these details.
 - 1. Provide the boxes with turning vanes or mitred round elbows with turning vanes for supply diffusers. Make branch connections into the sides of these boxes as detailed.
 - 2. Provide full size sheet metal boxes over return and exhaust grilles and registers. Make the boxes the minimum height shown on the Drawings. If no minimum height is given, then the minimum height shall be 10 inches. Make branch connections into the sides of these boxes as detailed.
- D. Install volume dampers in branch ducts at the locations shown on the Drawings. Do not install the dampers at the branch duct connection points to the grilles and diffusers.
- E. Provide volume dampers behind register or diffuser faces only behind sidewall outlets, and only where specifically indicated on the Drawings.

3.11 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in other sections.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. After the system is balanced, repair and/or replace any defective joints, seams, or any leakage problems where the balanced air flow is more than 10 per cent less than design air flow. In particular, check for leaks at duct connections to grilles and diffusers.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.13 DUCT CLEANING (to be used if duct does not pass above test)

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use duct cleaning methodology as indicated in NADCA ACR.
- C. Use service openings for entry and inspection.
 - 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.

D. Particulate Collection and Odor Control:

- 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
- 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- E. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.

F. Mechanical Cleaning Methodology:

- 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
- 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
- 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
- 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
- 5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- 6. Provide drainage and cleanup for wash-down procedures.
- 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.14 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.15 DUCT SEALING, TESTING AND LEAKAGE TABLES

Ductwork Indoors

| Duct System | Seal Class | Leakage Class | Test Pressure "W.G. | Allowable Leakage CFM/100SF |
|---|---------------|------------------|---------------------------|-----------------------------------|
| Supply air duct - round | A | 4 | 3 | 8.2 |
| Supply air duct - rectangular | | 4 | 3 | 8.2 |
| Exhaust duct - round | | 4 | 3 | 8.2 |
| Exhaust duct - rectangular | | 4 | 3 | 8.2 |
| Return and outside air duct - round | | 4 | 3 | 8.2 |
| Return and outside air duct - rectangular | | 4 | 3 | 8.2 |

Ductwork Outdoors

| Duct System | Seal Class | Leakage Class | Test Pressure "W.G. | Allowable Leakage CFM/100SF |
|--|---------------|------------------|---------------------------|-----------------------------------|
| Supply, return, and outside air duct - round | A | 4 | 3 | 8.2 |
| Supply, return, and outside air duct - rectangular | | 4 | 3 | 8.2 |

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Air blenders.
- 2. Takeoff fittings
- 3. Backdraft and pressure relief dampers.
- 4. Manual volume dampers.
- 5. Control dampers.
- 6. Fire dampers.
- 7. Smoke dampers.
- 8. Combination fire and smoke dampers.
- 9. Flange connectors.
- 10. Duct silencers.
- 11. Turning vanes.
- 12. Remote damper operators.
- 13. Duct-mounted access doors.
- 14. Flexible connectors.
- 15. Duct accessory hardware.
- B. Provide stainless steel duct accessories in stainless steel duct systems. Provide galvanized steel accessories in galvanized steel duct systems. Provide aluminum accessories in aluminum duct systems.
- C. Related Requirements:
 - 1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
 - Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Sustainable Design Submittals:
 - 1. Product data showing compliance with ASHRAE 62.1.

- Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Exposed-Surface Finish: Mill phosphatized.

- B. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- C. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 AIR BLENDERS:

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - 1. Blender Products, Inc.
 - 2. Kees.
- B. Air blenders shall be constructed of 0.08 gauge aluminum all welded construction. Blender shall consist of blade deflectors to prevent stratification and to provide equal air distribution through coils.

2.4 TAKE-OFF FITTINGS:

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Creative Metals
 - 2. Flexmaster
 - 3. United Air
- B. Provide spin-collar type take-off fittings where low pressure round branch ducts connect to low pressure rectangular main ducts. Construct fittings of 26 gauge galvanized steel. Provide joint on end of fitting so that fitting can be inserted in round opening in side of rectangular duct and locked in place with one quarter turn. Provide single blade round damper with wing nut and lever type position indicator in each fitting. Provide fittings without scoops or extractors.
- C. Provide standard "extended plenum" type rectangular-to-round take-off fittings with separate single blade volume damper in branch ducts where rectangular duct depth is too shallow to permit the use of spin-collar take-off fittings.

2.5 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Warming and Ventilating; a Mestek Architectural Group company.
 - 2. Cesco Products; a divsion of MESTEK, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.

- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1250 fpm (6.4 m/s).
- D. Maximum System Pressure: 3-inch wg (0.8 kPa).
- E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, off-center pivoted, maximum 6-inch (150-mm) width, 0.050-inch- (1.2-mm-) thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Nonferrous metal.
 - 2. Diameter: 0.20 inch (5 mm).
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Screen Mounting: Rear mounted.
 - 5. Screen Material: Aluminum.
 - 6. Screen Type: Bird.
 - 7. 90-degree stops.

2.6 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Warming and Ventilating; a Mestek Architectural Group company.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:

- a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
- b. Mitered and welded corners.
- c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

- a. Multiple or single blade.
- b. Parallel- or opposed-blade design.
- c. Stiffen damper blades for stability.
- d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
- 6. Blade Axles: Nonferrous metal.
- 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Galvanized steel.
- B. Low-Leakage, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Warming and Ventilating; a Mestek Architectural Group company.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.
 - 2. Comply with AMCA 500-D testing for damper rating.
 - 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 4. Suitable for horizontal or vertical applications.
 - 5. Frames:
 - a. Hat shaped.
 - b. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 6. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch (1.62 mm) thick.
 - 7. Blade Axles: Nonferrous metal.
 - 8. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

- 9. Blade Seals: Neoprene.
- 10. Jamb Seals: Cambered aluminum.
- 11. Tie Bars and Brackets: Galvanized steel.
- 12. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:

- 1. Size: 0.5-inch (13-mm) diameter.
- 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
- 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

- 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
- 2. Include center hole to suit damper operating-rod size.
- 3. Include elevated platform for insulated duct mounting.

2.7 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Warming and Ventilating; a Mestek Architectural Group company.
 - 2. Cesco Products; a divsion of MESTEK, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. McGill AirFlow LLC.
 - 5. Nailor Industries Inc.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

- 1. Hat shaped.
- 2. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
- 3. Mitered and welded corners.

D. Blades:

- 1. Multiple blade with maximum blade width of 6 inches (152 mm).
- 2. Opposed-blade design.
- 3. Galvanized-steel.
- 4. 0.064 inch (1.62 mm) thick single skin.
- 5. Blade Edging: Closed-cell neoprene.
- 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch- (13-mm-) diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

- 1. Oil-impregnated bronze.
- 2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 3. Thrust bearings at each end of every blade.

2.8 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Warming and Ventilating; a Mestek Architectural Group company.
 - 2. Cesco Products; a divsion of MESTEK, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
 - 1. Curtain type fire dampers with blade stack outside of the airstream must have the curtain portion blocked off at the frame, not at the ends of the sleeve.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.138 inch (3.5 mm) thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.024-inch- (0.61-mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Warming and Ventilating; a Mestek Architectural Group company.
 - 2. Cesco Products: a divsion of MESTEK, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. Provide UL 555S Leakage Class I rated dampers in primary air duct systems. Provide Leakage Class II rated dampers in other duct systems.
- C. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- D. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.
- E. Fire Rating: 1-1/2 and 3 hours.
- F. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.
- G. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.
- H. Smoke Detector: Integral, factory wired for single-point connection.
- I. Blades: Roll-formed, horizontal, interlocking, 0.063-inch- (1.6-mm-) thick, galvanized sheet steel.
- J. Leakage: Class I.
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: two-position action.
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in contract documents.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

- 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
- 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
- 7. Electrical Connection: 115 V, single phase, 60 Hz.
- P. As an option, the Contractor under this Specification Section may provide separate fire dampers and smoke dampers in locations requiring combination fire/smoke dampers.

2.10 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Ductmate Industries, Inc.
 - 2. Hardcast, Inc.
 - 3. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.11 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Dynasonics.
 - 2. McGill AirFlow LLC.
 - 3. Ruskin Company.
 - 4. Vibro-Acoustics.
- B. General Requirements:
 - 1. Factory fabricated.
 - 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
 - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Shape:
 - 1. Rectangular straight with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275), galvanized sheet steel, 0.034 inch (0.85 mm) thick.

- E. Inner Casing and Baffles: ASTM A 653/A 653M, G90 (Z275) galvanized sheet metal, 0.034 inch (0.85 mm) thick, and with 1/8-inch- (3-mm-) diameter perforations.
- F. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- G. Principal Sound-Absorbing Mechanism:
 - 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 - 2. Film-lined type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
 - 3. Lining: Tedlar.
- H. Where indicated, provide acoustic fill material completely encased in a polymer covering so that no portion of the fill material is exposed to the airstream.
- I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Joints: flanged connections.
 - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- J. Accessories:
 - 1. Factory-installed end caps to prevent contamination during shipping.
- K. Source Quality Control: Test according to ASTM E 477.
 - 1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm (10-m/s) face velocity.
 - 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.

2.12 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Hardcast, Inc.
 - 4. METALAIRE, Inc.
 - 5. SEMCO LLC.
 - 6. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall.

2.13 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Pottorff.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Stainless steel.

2.14 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Warming and Ventilating; a Mestek Architectural Group company.
 - 2. Cesco Products; a divsion of MESTEK, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. Ventfabrics, Inc.
 - 7. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch (25-by-25-mm)butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:

- a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
- b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
- c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
- d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Hardcast, Inc.
 - 4. Ventfabrics, Inc.
 - 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

2.16 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.
- H. Connect ducts to duct silencers with flexible duct connectors.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).

- 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
- 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
- 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
- 5. Body Access: 25 by 14 inches (635 by 355 mm).
- 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- L. Label access doors according to contract documents to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts with maximum 36-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with draw bands plus sheet metal screws.
- R. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ceiling-mounted ventilators.
 - 2. Centrifugal ventilators roof upblast.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
 - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Certified fan performance curves with system operating conditions indicated.
 - 4. Certified fan sound-power ratings.
 - 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 6. Material thickness and finishes, including color charts.
 - 7. Dampers, including housings, linkages, and operators.
 - 8. Prefabricated roof curbs.
 - 9. Fan speed controllers.

B. Shop Drawings:

- 1. Include plans, elevations, sections, and attachment details.
- 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include diagrams for power, signal, and control wiring.
- 4. Design Calculations: Calculate requirements for selecting vibration isolators.
- C. Delegated Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates that specified equipment will withstand required wind forces, from manufacturer.

- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
- 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
- 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, supports,, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- F. Wind Performance: Air-handling units shall withstand the effects of wind determined in accordance with to ASCE/SEI 7.

2.2 CEILING-MOUNTED VENTILATORS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Carnes Company</u>.
 - 2. Greenheck Fan Corporation.

- 3. <u>Loren Cook Company</u>.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.
- D. Back-draft damper: Integral.
- E. Grille: Stainless steel, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plugin
- G. Accessories:
 - 1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Isolation: Rubber-in-shear vibration isolators.

2.3 CENTRIFUGAL VENTILATORS - ROOF UPBLAST

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Carnes Company</u>.
 - 2. <u>Greenheck Fan Corporation</u>.
 - 3. <u>Loren Cook Company</u>.
- B. Configuration: Centrifugal roof upblast, grease hood kitchen ventilator.
- C. Housing: Removable spun aluminum; square, one-piece aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades; spark-resistant construction classified in accordance with AMCA 99, Section 8..
- E. Accessories:
 - 1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection, factory wired through an internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 - 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
 - 5. Spark-resistant, all-aluminum wheel construction.
 - 6. Mounting Pedestal: Galvanized steel with removable access panel.
 - 7. Restaurant Kitchen Exhaust: UL 762 listed for grease-laden air exhaust.

- F. Prefabricated Kitchen Exhaust Roof Curbs: Galvanized steel; mitered and welded corners; ventilation openings on all sides to ventilate curb interstitial space. Size as required to suit roof opening and fan base.
 - 1. Configuration: Built-in raised cant and mounting flange manufactured to accommodate roof slope.
 - 2. Hinged sub-base to provide access to damper or as cleanout for grease applications.
 - 3. Vented Curb: For kitchen exhaust; 12-inch- (300-mm-) high galvanized steel; unlined, with louvered vents in vertical sides.
 - 4. NFPA 96 code requirements for commercial cooking operations.
 - 5. Kitchen Hood Exhaust: UL 762 listed for grease-laden air.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.5 SOURCE QUALITY CONTROL

- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
 - 1. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See other sections for installation of roof curbs.
 - 2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
 - 3. Comply with requirements for vibration isolation devices specified in other sections.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in other sections.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to electrical sections.
- B. Ground equipment according to electrical sections.
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in electrical sections.
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to electrical sections.

3.5 STARTUP SERVICE:

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.
 - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and inspections.
 - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties.
 - 3. Fans and components will be considered defective if they do not pass tests and inspections.
 - 4. Prepare test and inspection reports.

3.9 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Rectangular and square ceiling diffusers.
- 2. Louver face diffusers.
- 3. Linear bar diffusers.
- 4. Linear slot diffusers.

B. Related Sections:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. Anemostat Products; a Mestek company
- 2. Carnes
- 3. Hart & Cooley Inc
- 4. Krueger
- 5. METALAIRE, Inc.
- 6. Nailor Industries Inc
- 7. Titus
- 8. Tuttle & Bailey

2.2 DIFFUSERS, REGISTERS AND GRILLES

A. Diffusers, registers, and grilles are scheduled on Drawings.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233813 - COMMERCIAL-KITCHEN HOODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial-kitchen hoods, Type I.
- B. Related Requirements:
 - Section 233533 "Listed Kitchen Ventilation System Exhaust Ducts" for fire-rated ducts connecting to kitchen hoods.

1.3 **DEFINITIONS**

- A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.
- B. Standard Hood: A hood, usually field fabricated, that complies with design, construction, and performance criteria of applicable national and local codes.
- C. Type I Hood: A hood designed for grease exhaust applications.
- D. Type II Hood: A hood designed for heat and steam removal and for other nongrease applications.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Standard hoods.
 - 2. Filters/baffles.
 - 3. Fire-suppression systems.
 - 4. Luminaires.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Shop Drawing Scale: 1/4 inch = 1 foot (1:50).

- 2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
- 3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
- 4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
- 5. Show control cabinets.
- 6. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
- 7. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 8. Design Calculations: Calculate requirements for selecting seismic restraints.
- 9. Include diagrams for power, signal, and control wiring.
- 10. Duct Connections: Detail connections between ducts and hoods, including access doors and panels.
- 11. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.
 - a. Piping Diagram Scale: 1/4 inch = 1 foot (1:50).
- C. Fire Marshal Submittal: Also, submit shop drawings and product data to the Fire Marshal's office for review. Shop drawings must be approved by the Fire Marshal's office.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Code Compliance: Comply with applicable portions of latest editions of the National Fire Code Pamphlet NFPA 96. Also comply with requirements of the Department of Housing, Buildings and Construction.
- C. UL Compliance: Provide equipment which have been listed and labeled by Underwriters Laboratories (UL).
- D. NSF Compliance: Provide hood bearing the National Sanitary Foundation (NSF) seal of approval.
- E. Field quality-control reports.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Grease Filters/Baffles: One complete set(s).

1.8 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A666, Type 304.
 - 1. Minimum Thickness: 0.037 inch (0.94 mm).
 - 2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
 - a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
 - 3. Concealed Stainless-Steel Surfaces: ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished finish).
 - 4. Exposed Surfaces: ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished).
 - 5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Carbon-Steel Sheets: ASTM A1008/A1008M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
 - 1. Minimum Thickness: 0.043 inch (1.09 mm).
- C. Sealant: ASTM C920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.
 - 1. Color: As selected by Architect from manufacturer's full range.
 - 2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- D. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.3 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
 - 1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
 - 2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
 - 3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.

- 4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
- 5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A780/A780M.
- B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.
- D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets unless otherwise indicated.
- J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- K. Fabricate enclosure panels to ceiling and wall as follows:
 - 1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
 - 2. Wall Offset Spacer: Minimum of 3 inches (75 mm).
 - 3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum 0.0625-inch- (1.58-mm-) thick, stainless-steel shelf tops.

2.4 EXHAUST HOOD FABRICATION, TYPE I HOOD

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. CaptiveAire Systems.
 - 2. <u>Greenheck Fan Corporation</u>.
- B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
 - 1. Fabricate hoods according to NSF 2, "Food Equipment."
 - 2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
 - 3. Include access panels as required for access to fire dampers and fusible links.

- 4. Duct Collars: Minimum 0.0598-inch- (1.5-mm-) thick steel at least 3 inches (75 mm) long, continuously welded to top of hood and at corners. Fabricate a collar with a 0.5-inch- (13-mm-) wide duct flange.
- C. Hood Configuration: Exhaust and makeup air.
 - 1. Makeup air shall be introduced through laminar-flow-type, perforated metal diffusers mounted in the ceiling in front of hood canopy. Furnish laminar-flow-type diffusers with baked white enamel finish and volume-control dampers.
- D. Hood Style: Wall-mounted canopy.
- E. Filters/Baffles: Removable, stainless-steel, with spring-loaded fastening. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Safety for Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- F. Luminaires: LED luminaires and lamps with lenses sealed vapor tight. Wiring shall be in conduit on hood exterior. Number and location of luminaires shall provide a minimum of 70 fc (753 lx) at 30 inches (762 mm) above finished floor.
 - 1. Light switches shall be mounted on front panel of hood canopy.
 - 2. Luminaires: LED complying with UL 1598.
- G. Comply with hood control requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- H. Hood Controls: Hood-mounting control cabinet, factory wired to control groups of adjacent hoods, and fabricated of stainless steel.
 - 1. Photocell and Temperature Control, Variable Speed: Vary speed of makeup air and exhaust-air fans with variable-frequency controllers, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity. Controller shall limit supply quantity for proper operation of makeup air unit.
 - 2. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.

2.5 FIRE-SUPPRESSION SYSTEM, WET CHEMICAL

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Ansul; brand of Johnson Controls International plc, Building Solutions North America.</u>
 - 2. <u>Badger Fire Protection; a Carrier company</u>.
 - 3. Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America.
- B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.
 - 1. Steel Pipe, NPS 2 (DN 50) and Smaller: ASTM A53/A53M, Type S, Grade A, Schedule 40, plain ends.

- 2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- 3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
- 4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
- 5. Furnish electric-operated gas shutoff valve; see "Facility Natural-Gas Piping."
- 6. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
- 7. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
- 8. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.
- C. Provide interlock points in each control cabinet for connection to the building fire alarm system so that activation of any chemical fire extinguishing system will activate the building fire alarm system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Coordinate equipment layout and installation with adjacent Work, including luminaires, HVAC equipment, plumbing, and fire-suppression system components.
- B. Complete field assembly of hoods where required.
 - 1. Make closed butt and contact joints that do not require filler.
 - 2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "General Hood Fabrication Requirements" Article.
- C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- D. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.

- F. Install hoods to operate free from vibration.
- G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches (1200 mm) o.c. maximum.
- H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- J. Set initial temperatures, and calibrate sensors.
- K. Set field-adjustable switches.

3.3 CONNECTIONS

- A. Where installing piping adjacent to hoods, allow space for service and maintenance.
- B. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.
- C. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."
- D. Provide interlock wiring between kitchen hood fire extinguishing systems gas valve and electric equipment shutoffs to control panels. Install wiring in metallic conduit. Install in accordance with National Electric Codes.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and inspections:
 - 1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test water, drain, gas, and liquid-carrying components for leaks. Repair or replace leaking components.
 - 4. Perform hood performance tests required by authorities having jurisdiction.
 - 5. Perform fire-suppression system performance tests required by authorities having jurisdiction.
- C. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial-kitchen hoods.

END OF SECTION 233813

SECTION 235123 - GAS VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Listed double-wall vents.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.
- B. Shop Drawings: For vents.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
 - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

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PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - 1. <u>Heat-Fab, Inc</u>.
 - 2. Metal-Fab, Inc.
 - 3. <u>Selkirk Corporation</u>.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F (248 deg C) continuously, with positive or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch (13-mm) airspace.
- D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.
- E. Outer Jacket: Aluminized steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: As required by equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Special Gas Vent: Condensing gas appliances.

3.3 INSTALLATION OF LISTED VENTS

- A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

GAS VENTS 235123 - 2

D. Lap joints in direction of flow.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 235123

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SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
 - ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- C. Shop Drawings: For boilers, boiler trim, and accessories.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- D. Delegated-Design Submittal: For each boiler.
 - 1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Fire-Tube Condensing Boilers:
 - a. Leakage and Materials: 10 years from date of Substantial Completion.
 - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Nonprorated for five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers Minimum Efficiency Requirements."
- D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.
- E. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- F. Kentucky Boiler Code: Provide boilers in accordance with Kentucky Boiler Code.
- G. CSA Compliance: Test boilers for compliance with CSA B51.
- H. Mounting Base: For securing boiler to concrete base.

2.2 FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Fulton Boiler Works, Inc.
 - 2. <u>AERCO International</u>, Inc.

- B. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.
- C. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber.
- D. Pressure Vessel: Carbon steel with welded heads and tube connections.
- E. Burner: Natural gas, forced draft.
- F. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.
 - Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- I. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: Baked-enamel protective finish.
 - 4. Insulation: Minimum 2-inch- (50-mm-) thick, [mineral-fiber] [polyurethane-foam] insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.

2.3 TRIM

- A. Include devices sized to comply with ASME B31.9.
- B. Aquastat Controllers: Operating, firing rate, and high limit.
- C. Safety Relief Valve: ASME rated.
- D. Pressure and Temperature Gage: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.
- E. Boiler Air Vent: Automatic.
- F. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end gate valve.

2.4 CONTROLS

A. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and contract drawings.

CONDENSING BOILERS

- B. Boiler operating controls shall include the following devices and features:
 - 1. Control transformer.
 - 2. Set-Point Adjust: Set points shall be adjustable.
 - 3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F (minus 17 deg C) outside-air temperature, set supply-water temperature at 200 deg F (93 deg C); at 60 deg F (15 deg C) outside-air temperature, set supply-water temperature at 140 deg F (60 deg C).
 - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
- C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
 - 1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
 - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
 - 3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
 - 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.
 - 1. Hardwired Points:
 - a. Monitoring: On/off status, common trouble alarm.
 - b. Control: On/off operation, hot-water-supply temperature set-point adjustment.
 - 2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.5 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.
- B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
 - 1. House in NEMA 250, Type 1 enclosure.
 - 2. Wiring shall be numbered and color coded to match wiring diagram.
 - 3. Install factory wiring outside of an enclosure in a metal raceway.
 - 4. Field power interface shall be to nonfused disconnect switch.
 - 5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.

6. Provide each motor with overcurrent protection.

2.6 VENTING KITS

- A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.
- B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.
- C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.
 - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Equipment Mounting:
 - 1. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified.
 - 2. Comply with requirements for vibration isolation devices specified in contract documents.
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service.
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required. Extend vent piping from burner manifold full size up through roof.
- F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.
- G. Install piping from safety relief valves to nearest floor drain.
- H. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections.
- I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- B. Boiler will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide onsite assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

E. Performance Tests:

- 1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
- 2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
- 3. Perform field performance tests to determine capacity and efficiency of boilers.
 - a. Test for full capacity.
 - b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.
- 4. Repeat tests until results comply with requirements indicated.
- 5. Provide analysis equipment required to determine performance.
- 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
- 7. Notify Architect 24 hours minimum in advance of test dates.
- 8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 235216

SECTION 236423.13 - AIR-COOLED, SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.3 **DEFINITIONS**

- A. BAS: Building automation system.
- B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- C. DDC: Direct digital control.
- D. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in Btu/h to the total power input given in watts at any given set of rating conditions.
- E. GFI: Ground fault interrupt.
- F. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.
- G. I/O: Input/output.
- H. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- I. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.
- J. SCCR: Short-circuit current rating.
- K. TEAO: Totally enclosed air over.
- L. TENV: Totally enclosed nonventilating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
- 2. Performance at AHRI standard conditions and at conditions indicated.
- 3. Performance at AHRI standard unloading conditions.
- 4. Minimum evaporator flow rate.
- 5. Refrigerant capacity of water chiller.
- 6. Oil capacity of water chiller.
- 7. Fluid capacity of evaporator.
- 8. Characteristics of safety relief valves.
- 9. Force and moment capacity of each piping connection.
- B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
 - 1. Assembled unit dimensions.
 - 2. Weight and load distribution.
 - 3. Required clearances for maintenance and operation.
 - 4. Size and location of piping and wiring connections.
 - 5. Diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates: For certification required in "Quality Assurance" Article.
- B. Installation instructions.
- C. Source quality-control reports.
- D. Startup service reports.
- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
- B. Spare Parts List: Recommended spare parts list with quantity for each.
- C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
- D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Tool kit to include the following:
 - 1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.
 - 2. Special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance.

- 3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit." Text size shall be at least 1 inch (25 mm) high.
- 4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 1/2 inch (13 mm) high.
- B. Touchup Paint: 32 oz. (1 L) container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

1.8 **QUALITY ASSURANCE**

A. AHRI Certification: Certify chiller according to AHRI 590 certification program.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.
- B. Package water chiller for export shipping.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified warranty period.
 - 1. Extended warranties include, but are not limited to, the following:
 - a. Complete chiller including refrigerant and oil charge.
 - b. Complete compressor and drive assembly including refrigerant and oil charge.
 - c. Refrigerant and oil charge.
 - 1) Loss of refrigerant charge for any reason due to manufacturer's product defect and product installation.
 - d. Parts and labor.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590.
- B. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."
- D. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

- E. Comply with NFPA 70.
- F. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.
- G. Operation Following Loss of Normal Power:
 - 1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought on-line.
 - 2. See drawings for equipment served by backup power systems.
 - 3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

H. Outdoor Installations:

- 1. Chiller shall be suitable for outdoor installation indicated. Provide adequate weather protection to ensure reliable service life over a 25-year period with minimal degradation due to exposure to outdoor ambient conditions.
- 2. Chillers equipped to provide safe and stable operation while achieving performance indicated when operating at extreme outdoor temperatures encountered by the installation. Review historical weather database and provide equipment that can operate at extreme outdoor temperatures recorded over past 30-year period.

2.2 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Carrier Global Corporation</u>.
 - 2. <u>Daikin Applied</u>.
 - 3. YORK; brand of Johnson Controls International plc, Building Solutions North America.

2.3 MANUFACTURED UNITS

- A. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, condenser with fans, electrical power, controls, and indicated accessories.
- B. Fabricate water chiller mounting base with reinforcement strong enough to resist water chiller movement during a seismic event when water chiller is anchored to field support structure.
- C. Sound-reduction package shall have the following:
 - 1. Acoustic enclosure around compressors.
 - 2. Reduced-speed fans with acoustic treatment.
 - 3. Designed to reduce sound level without affecting performance.
- D. Security Package: Security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

2.4 CABINET

- A. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
- B. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
- C. Casing: Galvanized steel.
- D. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.

2.5 COMPRESSOR-DRIVE ASSEMBLIES

A. Compressors:

- 1. Description: Positive-displacement direct drive with hermetically sealed casing.
- Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
 - a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.
- 3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
- 4. Capacity Control: On-off compressor cycling, plus hot-gas bypass.
 - a. Digital compressor unloading is an acceptable alternative to achieve capacity control.
- 5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug or removable magnet in sump, and initial oil charge.
 - a. Manufacturer's other standard methods of providing positive lubrication are acceptable in lieu of an automatic pump.

B. Compressor Motors:

- 1. Hermetically sealed and cooled by refrigerant suction gas.
- 2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

C. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

2.6 REFRIGERATION

- A. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.
- B. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- C. Refrigerant Circuit: Each circuit shall include an electronic or a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line

shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.

- D. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.
 - 1. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in each circuit in lieu of each compressor.

E. Pressure Relief Device:

- 1. Comply with requirements in ASHRAE 15, ASHRAE 147, and applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- Select and configure pressure relief devices to protect against corrosion and inadvertent release of refrigerant.
- 3. ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger.

2.7 EVAPORATOR

A. Shell and Tube:

- 1. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
- 2. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
- 3. Shell Material: Carbon steel.
- 4. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
- 5. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping. Furnish flange adapters to mate to flanged piping.
- 6. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.

B. Brazed Plate:

- 1. Direct-expansion, single-pass, brazed-plate design.
- 2. Type 304 stainless-steel construction.
- 3. Code Compliance: Tested according to ASME Boiler and Pressure Vessel Code.
- 4. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping. Furnish flange adapters to mate to flanged piping.
- 5. Inlet Strainer: Factory-furnished, 20 or 40-mesh strainer for field installation in supply piping to evaporator. Manufacturer has option to factory install strainer.
- C. Flow Switch: Factory-furnished and -installed, flow switch wired to chiller operating controls.
- D. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F (minus 29 deg C).

2.8 AIR-COOLED CONDENSER

A. Coil(s) with integral subcooling on each circuit.

- B. Copper Tube with Plate Fin Coils:
 - 1. Construct coils of copper tubes mechanically bonded to aluminum fins.
- C. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- D. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
- E. Fan Motors: TENV or TEAO enclosure, with sealed and permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
 - 1. Overcurrent- and thermal-overload protection not integral to motor is acceptable if provided with chiller electrical power package.
- F. Fan Guards: Removable steel safety guards with corrosion-resistant [PVC] coating.

2.9 INSULATION

- A. Closed-cell, flexible, elastomeric thermal insulation complying with ASTM C 534/C 534M, Type I for tubular materials and Type II for sheet materials.
 - 1. Thickness: 3/4 inch (19 mm).
- B. Adhesive: As recommended by insulation manufacturer.
- C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
 - 1. Apply adhesive to 100 percent of insulation contact surface.
 - 2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
 - 3. Seal seams and joints to provide a vapor barrier.
 - 4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
 - 5. Manufacturer has option to factory or field insulate chiller components to reduce potential for damage during installation.
 - 6. Field-Applied Insulation:
 - a. Components that are not factory insulated shall be field insulated to comply with requirements indicated.
 - b. Manufacturer shall be responsible for chiller insulation whether factory or field installed to ensure that manufacturer is the single point of responsibility for chillers.
 - c. Manufacturer's factory-authorized service representative shall instruct and supervise installation of field-applied insulation.
 - d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

2.10 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

- B. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
- C. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
- D. Wiring shall be numbered and color-coded to match wiring diagram.
- E. Factory wiring shall be located outside of an enclosure in a metal raceway. Terminal connections shall be made with not more than a 24-inch (610-mm) length of liquidight or flexible metallic conduit.
- F. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 42,000 A.
- G. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - 1. NEMA KS 1, heavy-duty, nonfusible switch.
- H. Each motor shall have overcurrent protection.
- I. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
- J. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
- K. Power Factor Correction: Capacitors to correct power factor to 0.90 at full load.
- L. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- M. Control Relays: Auxiliary and adjustable time-delay relays, or an integral to water chiller microprocessor.
- N. Service Receptacle:
 - 1. Unit-mounted, 120-V GFI duplex receptacle.
 - 2. Power receptacle from chiller internal electrical power wiring.
- O. Indicate the following for water chiller electrical power supply:
 - 1. Current, phase to phase, for all three phases.
 - 2. Voltage, phase to phase and phase to neutral for all three phases.
 - 3. Three-phase real power (kilowatts).
 - 4. Three-phase reactive power (kilovolt amperes reactive).
 - Power factor.
 - 6. Running log of total power versus time (kilowatt hours).
 - 7. Fault log, with time and date of each.

2.11 CONTROLS

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Standalone, microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.

- C. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
- D. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, digital display. Display the following:
 - 1. Date and time.
 - 2. Operating or alarm status.
 - 3. Operating hours.
 - 4. Outside-air temperature if required for chilled-water reset.
 - 5. Temperature and pressure of operating set points.
 - 6. Chilled-water entering and leaving temperatures.
 - 7. Refrigerant pressures in evaporator and condenser.
 - 8. Saturation temperature in evaporator and condenser.
 - 9. No cooling load condition.
 - 10. Elapsed time meter (compressor run status).
 - 11. Pump status.
 - 12. Antirecycling timer status.
 - 13. Percent of maximum motor amperage.
 - 14. Current-limit set point.
 - 15. Number of compressor starts.
 - 16. Alarm history with retention of operational data before unit shutdown.
 - 17. Superheat.

E. Control Functions:

- 1. Manual or automatic startup and shutdown time schedule.
- 2. Capacity control based on evaporator leaving-fluid temperature.
- 3. Capacity control compensated by rate of change of evaporator entering-fluid temperature.
- 4. Chilled-water entering and leaving temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
- 5. Current limit and demand limit.
- 6. Condenser-water temperature.
- 7. External water chiller emergency stop.
- 8. Antirecycling timer.
- 9. Automatic lead-lag switching.
- F. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
 - 1. Low evaporator pressure or high condenser pressure.
 - 2. Low chilled-water temperature.
 - 3. Refrigerant high pressure.
 - 4. High or low oil pressure.
 - 5. High oil temperature.
 - 6. Loss of chilled-water flow.
 - 7. Loss of condenser-water flow.
 - 8. Control device failure.
 - Communication Interface: ASHRAE 135 (BACnet) communication interface shall enable control
 system operator to remotely control and monitor the water chiller from an operator workstation.
 Control features and monitoring points displayed locally at water chiller control panel shall be
 available through DDC system for HVAC.
- G. Factory-installed wiring outside of enclosures shall be in NFPA 70-complaint raceway. Make terminal connections with liquidtight or flexible metallic conduit.

2.12 SOURCE QUALITY CONTROL

- A. Perform functional test of water chillers before shipping.
- B. Factory test and inspect evaporatoraccording to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- C. For water chillers located outdoors, rate sound power level according to AHRI 370 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
 - 1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

- A. Coordinate sizes and locations of bases with actual equipment provided. Cast anchor-bolt inserts into concrete bases.
- B. Equipment Mounting:
 - 1. Install water chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in other sections.
 - 2. Comply with requirements for vibration isolation devices specified in other sections.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Maintain clearances required by governing code.
- E. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- F. Install separate devices furnished by manufacturer and not factory installed.
 - 1. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-trained service personnel.

3.3 PIPING CONNECTIONS

- A. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to chillers, allow space for service and maintenance.

C. Evaporator Fluid Connections:

- 1. Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage.
- 2. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve.
- 3. Make connections to water chiller with a flange.
- D. Connect each drain connection with a drain valve, full size of drain connection.
- E. Connect each chiller vent connection with an automatic or a manual vent, full size of vent connection.

3.4 ELECTRICAL POWER CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high. Locate nameplate where easily visible.

3.5 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.
- C. Connect control wiring between chiller control interface and DDC system for remote monitoring and control of chillers. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."
- D. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
 - 2. Verify that pumps are installed and functional.
 - 3. Verify that thermometers and gages are installed.
 - 4. Operate water chiller for run-in period.

- 5. Check bearing lubrication and oil levels.
- 6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
- 7. Verify proper motor rotation.
- 8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
- 9. Verify and record performance of chilled-water flow and low-temperature interlocks.
- 10. Verify and record performance of water chiller protection devices.
- 11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.
- E. Prepare a written startup report that records results of tests and inspections.

3.7 **DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions and provide electronic copy to Owner.
 - 1. Instructor shall be factory trained and certified.
 - 2. Provide not less than eight hours of training.
 - 3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
 - 4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
 - 5. Obtain Owner sign-off that training is complete.
 - 6. Owner training shall be held at Project site.

END OF SECTION 236423.13

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes factory-assembled, dedicated outdoor air-handling units, including multiple components, capable of heating and cooling 100 percent outdoor air.

1.3 **DEFINITIONS:**

- A. ECM: Electronically commutated motor.
- B. ISCOP: Integrated Seasonal Coefficient of Performance.
- C. ISMRE: Integrated Seasonal Moisture Removal Efficiency.
- D. MRC: Moisture Removal Capacity.

1.4 ACTION SUBMITTALS

- A. Product Data: For each dedicated outdoor-air unit.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include unit dimensions and weight.
 - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
 - 5. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 - 6. Include certified coil-performance ratings with system operating conditions indicated.
 - 7. Include filters with performance characteristics.
 - 8. Include heat exchangers with performance characteristics.
 - 9. Include dampers, including housings, linkages, and operators.
- B. Shop Drawings: For each dedicated outdoor-air unit.
 - 1. Include plans, elevations, sections, and mounting details.

- 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include diagrams for power, signal, and control wiring.
- C. Delegated Design Submittal: For dedicated outdoor-air-unit supports indicated to comply with performance and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Include design calculations for selecting vibration isolators wind restraints, and for designing vibration isolation bases.
 - Wind-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's warranty.
- B. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Source quality-control reports.
- D. Startup service reports.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dedicated outdoor-air units to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: One set(s) for each belt-driven fan.
 - 2. Filters: One set(s) for each unit.
 - 3. Gaskets: One set(s) for each access door.

1.8 WARRANTY

- A. Warranty: Manufacturer agrees to replace components of dedicated outdoor-air units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Dedicated Outdoor-Air-Handling Units: Two years from date of Substantial Completion.
 - 2. Warranty Period for Compressors: Five years from date of Substantial Completion.
 - 3. Warranty Period for Heat Exchangers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an "NRTL" (nationally recognized testing laboratory), and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and Startup."
- D. ASHRAE 15 and ASHRAE 34 Compliance: For refrigeration system safety.
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."
- F. UL Compliance:
 - 1. Electric Coils: Comply with requirements in UL 1995.
- G. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation wind restraints.
- H. Wind-Restraint Performance:
 - 1. See Section 230548.13 "Vibration Controls for HVAC" for requirements.

2.2 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AAON.
 - 2. Addison.
 - 3. Daikin.
- B. Source Limitations: Obtain dedicated outdoor-air units from single manufacturer.

2.3 UNIT CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Configuration: Horizontal unit with horizontal discharge for concrete-base installation.
- C. Double-Wall Configuration:
 - 1. Outside Casing Wall: Galvanized steel, minimum 18 gauge (1.3 mm) thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 - 2. Inside Casing Wall:
 - a. Inside Casing, Burner Section: Galvanized steel, solid, minimum 14-gauge- (0.759-mm-) thick steel.
 - b. Inside Casing, All Other Sections: Galvanized steel, solid.
 - 3. Floor Plate: Reinforced metal surface; reinforced to limit deflection when walked on by service personnel. Insulation is provided below metal walking surface.
 - 4. Roof: Standing seam or membrane; sloped to drain water.
 - 5. Casing Insulation:
 - a. Materials: Polyurethane foam insulation.
 - b. Casing Panel R-Value: Minimum R-6.5.
 - c. Insulation Thickness: 1 inches (25 mm).
 - d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.
- D. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- E. Static-Pressure Classifications:
 - 1. For Unit Sections Upstream of Fans: Minus 3 inches wg (750 Pa).
 - 2. For Unit Sections Downstream and Including Fans: 2 inches wg (500 Pa).
- F. Panels and Doors:
 - 1. Panels:
 - a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
 - b. Fasteners: Two or more camlock-type fasteners for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components
 - 2. Doors:
 - a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
 - b. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.

- c. Gasket: Neoprene, applied around entire perimeters of panel frames.
- d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components.
- 3. Locations and Applications:
 - Fan Section: Doors.
 - b. Access Section: Doors.
 - c. Gas-Fired Burner Section: Doors.
 - d. Damper Section: Doors.
 - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
- G. Condensate Drain Pans:
 - 1. Location: Each refrigerant coil.
 - 2. Construction:
 - a. Single-wall, stainless steel sheet.
 - Size: Large enough to collect condensate from cooling coils, including coil piping connections, coil headers, and return bends.
 - 4. Drain Connection:
 - Terminated with threaded nipple.
 - 5. Slope: Minimum 0.125-inch/ft. (10-mm/m) slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
 - 6. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
 - 7. Width: Entire width of water-producing device.
 - 8. Depth: A minimum of 2 inches (50 mm) deep.
 - 9. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
 - 10. Provide units having stacked coils with intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
- B. Supply-Air Fans and Relief-Air Fans: Centrifugal; galvanized or painted steel; mounted on solid-steel shaft.
 - 1. Shafts: With field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway.
 - 2. Shaft Bearings:
 - a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours in accordance with ABMA 9.
 - 3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
 - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

- 4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
- 5. Backward-Inclined, Centrifugal Fan Wheels: Construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; hub riveted to backplate and fastened to shaft with setscrews.
- 6. Mounting: For internal vibration isolation. Factory mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch (25 mm).
- 7. Shaft Lubrication Lines: Extended to a location outside the casing.
- 8. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches (89 mm) wide, attached to two strips of minimum 2-3/4-inch- (70-mm-) wide by 0.028-inch- (0.7-mm-) thick, galvanized-steel sheet.
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
- C. Drive, Direct: Factory-mounted direct drive.
- D. Drive, Belt: Factory-mounted V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
 - 1. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
 - 2. Belts: Oil resistant, nonsparking and nonstatic; in matched sets for multiple-belt drives.
 - 3. Belt Guards: Comply with requirements specified by OSHA and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards"; 0.146 inch (2.7 mm) thick, 3/4-inch (20-mm) diamond-mesh wire screen, welded to steel angle frame; prime coated.
- E. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated electronically commutated motors.

F. Motors:

- Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- 3. Enclosure Type: Open, dripproof.
- 4. Efficiency: Premium efficient as defined in NEMA MG 1.
- 5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
- 6. Mount unit-mounted disconnect switches on of unit.
- G. Variable-Frequency Motor Controller:
 - 1. Manufactured Units: Pulse-width modulated; for inverter-duty motors.
 - 2. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
 - 3. Unit Operating Requirements:
 - a. Internal Adjustability:
 - 1) Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2) Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3) Acceleration: 0.1 to 999.9 seconds.

- 4) Deceleration: 0.1 to 999.9 seconds.
- 5) Current Limit: 30 to minimum of 150 percent of maximum rating.

b. Self-Protection and Reliability Features:

- 1) Surge suppression.
- 2) Loss of input signal protection.
- 3) Under- and overvoltage trips.
- 4) Variable-frequency motor controller and motor-overload/overtemperature protection.
- 5) Critical frequency rejection.
- 6) Loss-of-phase protection.
- 7) Reverse-phase protection.
- 8) Motor-overtemperature fault.
- c. Bidirectional autospeed search.
- d. Torque boost.
- e. Motor temperature compensation at slow speeds.
 - 1) Panel-mounted operator station.
 - 2) Historical logging information and displays.
 - 3) Digital indicating devices.
- f. Control Signal Interface: Electric.
- g. Proportional Integral Directive (PID) control interface.
- h. DDC system for HVAC Protocols for Network Communications: ASHRAE 135.

4. Line Conditioning:

- a. Input line conditioning.
- b. Output filtering.
- c. EMI/RFI filtering.

5. Bypass Systems:

- a. Bypass Mode: Field-selectable automatic or manual.
- b. Bypass Controller, Two-Contactor Style: With bypass and output isolating contactors and isolating switch.
- c. Bypass Contactor Configuration: Full-voltage (across the line) type.

2.5 COILS

A. General Requirements for Coils:

- 1. Comply with AHRI 410.
- 2. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow inplace access for service and maintenance of coil(s).
- 3. Coils are not to act as structural component of unit.

B. Supply-Air Refrigerant Coils:

- 1. Tubes: Copper.
- 2. Fins:
 - a. Material: Aluminum.

- 3. Fin and Tube Joints: Mechanical bond.
- 4. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.
 - a. Working Pressure: Minimum 300 psig (2070 kPa).
- C. Hot-Gas Reheat Refrigerant Coils:
 - 1. Tubes: Copper.
 - 2. Fins:
 - a. Material: Aluminum.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.
 - a. Working Pressure: Minimum 300 psig (2070 kPa).
 - 5. Suction-discharge bypass valve.
- D. Condenser Refrigerant coils:
 - 1. Tube Material: Copper.
 - 2. Fin Material: Aluminum.
 - 3. Fin and Tube Joint: Mechanical bond.

2.6 REFRIGERATION CIRCUIT COMPONENTS

- A. Compressors: Hermetic, variable-speed scroll compressors, mounted on integral vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- B. Refrigerant: R-410A.
- C. Refrigeration Specialties:
 - 1. Expansion valve with replaceable thermostatic element.
 - 2. Refrigerant filter/dryer.
 - 3. Manual-reset high-pressure safety switch.
 - 4. Automatic-reset low-pressure safety switch.
 - 5. Minimum off-time relay.
 - 6. Automatic-reset compressor motor thermal overload.
 - 7. Thermostat for coil freeze-up protection during low-ambient-temperature operation or loss of air.
 - 8. Brass service valves installed in discharge and liquid lines.
 - 9. Low-ambient kit high-pressure sensor.
 - 10. Single compressor with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and to reheat for humidity control.
 - 11. Modulating hot-gas reheat solenoid valve with a replaceable magnetic coil.
 - 12. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification for single-speed compressor.

2.7 AIR FILTRATION

- A. Particulate air filtration is specified in Section 234100 "Particulate Air Filtration."
- B. Panel Filters:

- 1. Description: Pleated factory-fabricated, self-supported disposable air filters with holding frames.
- 2. Filter Unit Class: UL 900.
- 3. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
- 4. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

C. Mounting Frames:

- 1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
- 2. Cartridge filters arranged for flat orientation, removable from access plenum.
- 3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.8 INDIRECT-FIRED GAS FURNACE HEATING

- A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47 and with NFPA 54.
- B. CSA Approval: Designed and certified by and bearing label of CSA.
- C. Burners:
 - 1. Heat-Exchanger Material: Stainless steel.
 - 2. Fuel: Natural gas.
 - 3. Ignition: Electronically controlled electric spark with flame sensor.
 - 4. Gas Control Valve: Electronic modulating.
 - 5. Gas Train: Single-body, regulated, redundant, 24 V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.
- D. Venting, Gravity: Gravity vented.
- E. Heat-Exchanger Drain Pan: Stainless steel.
- F. Safety Controls:
 - 1. Gas Manifold: Safety switches and controls complying with ANSI standards.
 - 2. Vent Flow Verification: Differential pressure switch to verify open vent.
 - 3. High Limit: Thermal switch or fuse to stop burner.
 - 4. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
 - 5. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
 - 6. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
 - 7. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.

2.9 DAMPERS

- A. Dampers: Comply with requirements in Section 230923.12 "Control Dampers."
- B. Outdoor- and Relief-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-

steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. (20 L/s per sq. m) at 1 inch wg (250 Pa) and 8 cfm/sq. ft. (40 L/s per sq. m) at 4 inches wg (1.0 MPa).

C. Electronic Damper Operators:

- 1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
- 2. Electronic damper position indicator shall have visual scale indicating percentage of travel and 2 to 10 V dc feedback signal.
- 3. Operator Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
- 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
- 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
- 6. Size dampers for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. (49.6 kg-cm/sq. m) of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
 - e. Dampers with 2 to 3 Inches wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
 - f. Dampers with 3 to 4 Inches wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
- 7. Coupling: V-bolt and V-shaped, toothed cradle.
- 8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
- 9. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
- 10. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.
- 11. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2 to 10 V dc position feedback signal.
- 12. Temperature Rating: [Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C)] [40 to 104 deg F (5 to 40 deg C)].

2.10 ELECTRICAL POWER CONNECTIONS

- A. Single-Point Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.
- C. Wiring: Numbered and color-coded to match wiring diagram.

- D. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- E. Power Interface: Field power interface to be NEMA KS 1, heavy-duty, nonfused disconnect switch.
- F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
 - 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection in accordance with IEC 60947-4-1.
 - 2. NEMA KS 1, heavy-duty, nonfusible switch.
 - 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- G. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- I. Controls: Factory wire unit-mounted controls where indicated.
 - 1. Service Lights: LED vaporproof luminaire with individual switched junction box, adjacent to each access door and panel.
 - a. Locations: Each section accessed with door or panel.
 - 2. Convenience Outlets: One 20 A duplex GFCI receptacle per location with junction box located on outside casing wall.
- J. Control Relays: Auxiliary and adjustable time-delay relays.

2.11 CONTROLS

- A. Control Wiring: Factory wire connection for controls' power supply.
- B. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.
- C. Unit-Mounted Status Panel:
 - 1. Cooling/Off/Heating Controls: Control operational mode.
 - 2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
 - 3. Status Lights:
 - a. Filter dirty.
 - b. Fan operating.
 - c. Cooling operating.
 - d. Heating operating.
 - e. Smoke alarm.
 - f. General alarm.
 - 4. Digital Numeric Display:
 - a. Outdoor airflow.
 - b. Supply airflow.

- c. Outdoor dry-bulb temperature.
- d. Outdoor dew point temperature.
- e. Space temperature.
- f. Supply temperature.
- g. Space relative humidity.

D. Refrigeration System Controls:

- 1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb (65 kJ/kg) of dry air or outdoor-air temperature is less than 60 deg F (15 deg C).
- 2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F (15 deg C).
- 3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

E. Furnace Controls:

- 1. Factory-mounted sensor in supply outlet with sensor adjustment located in control panel to modulate gas furnace burner to maintain space temperature.
- 2. Remote Setback: Adjustable room thermostat selected by timer, set at 50 deg F (10 deg C); cycles supply fan and gas furnace burner to maintain space temperature.
- 3. Burner Control: Modulating.
- F. Damper Controls: Space-pressure sensor modulates outdoor- and relief-air dampers to maintain a positive pressure in space at a minimum of [0.05 inch wg (12.4 Pa)] < Insert value > with respect to outdoor reference.
- G. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified. Links shall include the following:
 - 1. Start/stop interface relay and relay to notify DDC temperature-control system alarm condition.
 - 2. Hardware interface or additional sensors for the following:
 - a. Room temperature.
 - b. Discharge-air temperature.
 - c. Refrigeration system operation.
 - d. Furnace operation.
 - 3. ASHRAE 135 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

2.12 INTAKE OPENINGS

- A. Type: Manufacturer's standard hood or louver, including moisture eliminator, at all unit intake and relief openings.
- B. Materials: Match material and finish of casing exterior.
- C. Bird Screen: Comply with requirements in ASHRAE 62.1.
- D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.13 MATERIALS

- A. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 - 1. Manufacturer's standard grade for casing.
 - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209 (ASTM B209M).

2.14 SOURCE QUALITY CONTROL

- A. AHRI 920: Manufacturer to certify that performance ratings are in accordance with AHRI 920 if AHRI 920 certification program is not in place. Provide AHRI 920 certification if AHRI 920 certification program is in place.
- B. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label unit fan sound ratings in accordance with AHRI 260 or AMCA 311.
- C. Fan Aerodynamic Performance Rating: Test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency.
- D. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.
- E. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.
- F. Damper Leakage and Air Performance:
 - 1. Damper Rating: Test and rate dampers for leakage and air performance in accordance with AMCA 510.

2.

G. Refrigerant Coils: Factory tested to minimum 300 psig (2070 kPa) internal pressure and to minimum 300 psig (2070 kPa) internal pressure while under water, in accordance with AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

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- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Unit Support: Install unit level on structural curbs. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of curbs with actual equipment provided.
 - 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- C. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.
- Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300
 "Air Duct Accessories."
- E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- F. Comply with requirements for gas-fired furnace installation in NFPA 54.
- G. Install separate devices furnished by manufacturer and not factory installed.
- H. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Connect piping to units mounted on vibration isolators with flexible connectors.
- D. Gas Piping: Comply with requirements in other sections. Provide AGA-approved flexible connectors.
 - 1. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
 - 2. Install AGA-approved flexible connectors.
- E. Hydronic Piping Connections:
 - 1. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
 - 2. Install shutoff valve and union or flange on each supply connection, and install balancing valve and union or flange on each return connection.

F. Duct Connections:

- 1. Comply with requirements in Section 233113 "Metal Ducts."
- 2. Drawings indicate the general arrangement of ducts.
- 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with electrical sections.
- B. Ground equipment in accordance with electrical sections.
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in electrical sections.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with electrical sections.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Inspect units for visible damage to furnace combustion chamber.
 - 3. Perform the following operations for both minimum and maximum firing, and adjust burner for peak efficiency:
 - Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 - 4. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
 - 5. Start refrigeration system when outdoor-air temperature is within normal operating limits. and measure and record the following:
 - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.

- d. Condenser coil leaving-air dry-bulb temperature.
- 6. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
- 7. Inspect casing insulation for integrity, moisture content, and adhesion.
- 8. Verify that clearances have been provided for servicing.
- 9. Verify that controls are connected and operable.
- 10. Verify that filters are installed.
- 11. Clean coils and inspect for construction debris.
- 12. Clean furnace flue and inspect for construction debris.
- 13. Inspect operation of power vents.
- 14. Purge gas line.
- 15. Verify bearing lubrication.
- 16. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
- 17. Adjust fan belts to proper alignment and tension.
- 18. Start unit.
- 19. Inspect and record performance of interlocks and protective devices, including response to smoke detectors by fan controls and fire alarm.
- 20. Operate unit for run-in period.
- 21. Calibrate controls.
- 22. Adjust and inspect high-temperature limits.
- 23. Verify operational sequence of controls.
- 24. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.7 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

A. After completing system installation; testing, adjusting, and balancing dedicated outdoor-air unit and air-distribution systems; and completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, casings, dampers, coils, and filter housings, and install new, clean filters.

3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and inspections:
 - 1. Charge refrigerant coils with refrigerant and test for leaks.
 - 2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.10 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Filters: One set(s) for each air-handling unit.
- 2. Gaskets: One set(s) for each access door.
- 3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 "Outdoor Air Quality," Section 5 "Systems and Equipment," Section 6 " Procedures," and Section 7 "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: One year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Daikin.
 - 2. Carrier Global Corporation.
 - 3. Lennox Industries, Inc.; Lennox International.

2.2 INDOOR UNITS (5 TONS (18 kW) OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
 - 1. Cabinet: Removable panels on front and ends, and discharge drain pans with drain connection.
 - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 - 3. Fan: Direct drive, centrifugal.
 - 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - d. Mount unit-mounted disconnect switches on exterior of unit.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - 6. Condensate Drain Pans:
 - a. Fabricated to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends), and to direct water toward drain connection.
 - b. Drain Connection: Located at lowest point of pan and sized to prevent overflow.

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

- A. Air-Cooled, Compressor-Condenser Components:
 - 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
 - 3. Fan: Aluminum-propeller type, directly connected to motor.
 - 4. Motor: Permanently lubricated, with integral thermal-overload protection.
 - 5. Low Ambient Kit: Permits operation down to 0 deg F.

2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in documents.
- B. Thermostat: Control compressor and evaporator fan, with the following features:

- 1. Compressor time delay.
- 2. 24-hour time control of system stop and start.
- 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
- 4. Fan-speed selection including auto setting.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. Provide DDC interface to meet control requirements shown in documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in documents. Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in documents.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ductless fan coil units and accessories.
 - 2. Ducted fan coil units and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
 - 1. <u>Product Data</u>: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 "Systems and Equipment."
- C. Shop Drawings:
 - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Include diagrams for power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of fan coil unit indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which fan coil units will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fan coil units to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Coil Unit Filters: Furnish1 spare filter for each filter installed.
 - 2. Fan Belts: Furnish1 spare fan belts for each unit installed.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and Startup."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."

1.8 COORDINATION

A. Coordinate layout and installation of fan coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTLESS FAN COIL UNITS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Carrier Corporation; a unit of United Technologies Corp.
 - 2. <u>Daikin Applied</u>.
 - 3. ENVIRO-TEC; by Johnson Controls, Inc.
- B. Coil Section Insulation: 1/2-inch- (13-mm-) thick, foil-covered, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Main and Auxiliary Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.
- D. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panel. Floor-mounting units shall have leveling screws.
- E. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color as selected by Architect .
 - 1. Vertical Unit Front Panels: Removable, steel, with steel discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
 - 2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with cast-aluminum discharge grilles.
 - 3. Steel recessing flanges for recessing fan coil units into ceiling or wall.
- F. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.
 - 1. MERV Rating: 6 when tested according to ASHRAE 52.2.
 - 2. Washable Foam: 70 percent arrestance and MERV[3].
 - 3. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV[5].
 - 4. Pleated Cotton-Polyester Media: 90 percent arrestance and MERV 7.
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

- H. Fan and Motor Board: Removable.
 - 1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 - 2. Motor: Permanently lubricated, ECM; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 3. Wiring Termination: Connect motor to chassis wiring with plug connection.
- I. Control devices and operational sequences are specified in specifications and drawings.
- J. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.3 DUCTED FAN COIL UNITS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Carrier Corporation</u>; a unit of United Technologies Corp.
 - 2. <u>Daikin Applied</u>.
 - 3. ENVIRO-TEC; by Johnson Controls, Inc.
- B. Coil Section Insulation: 1/2-inch- (13-mm-) thick, foil-covered, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Main and Auxiliary Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.
- D. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panel. Floor-mounting units shall have leveling screws.
- E. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
 - 1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis.
 - 2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
 - 3. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.
- F. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.
- G. MERV Rating: 6 when tested according to ASHRAE 52.2.
 - 1. Pleated Cotton-Polyester Media: 90 percent arrestance and MERV 7.
- H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.

- Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, ECM motor
 resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanizedsteel fan scrolls.
 - 1. Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
- J. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, ECM motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
 - Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
- K. Control devices and operational sequence are specified in specifications and on drawings.
- L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, to receive fan coil units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan coil unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fan coil units level and plumb.
- B. Install fan coil units to comply with NFPA 90A.
- C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified.
- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above finished floor.
- E. Install new filters in each fan coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Install piping adjacent to machine to allow service and maintenance.

- Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
- 3. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.
- B. Connect supply-air and return-air ducts to fan coil units with flexible duct connectors. Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide onsite assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 238219

DIVISION 26 – ELECTRICAL

SECTION 260000 - GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1 REVIT

- A. The plans, sections and risers were made with REVIT. This program has some limitations on the types of devices, equipment and accessories... that can be show. The contractor should review the specifications and details for the proper type of devices, equipment and accessories... because what is shown on the plans may be the "closest" available within the limitations of REVIT and not exactly what is required by the contract specifications and details.
- B. Mounting heights may have been modified to show elements on the correct floor plan for bidding. Coordinate with the architect and engineer if it is not clear.
- C. Components may be orientated for clarity. Actual components shall be orientated as required by specifications, service requirements or manufacturers recommendations.

1.2 GENERAL

- A. The General Conditions, Special Conditions, Supplemental Conditions, Instructions to Bidders, and other Contract Documents apply to this branch of the work as well as to the other branches.
- B. The Contractor shall familiarize himself with the work of all other trades, general type construction, and the relationship of his work to other sections. He shall examine all working drawings, specifications and conditions affecting his work. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, verify all dimensions in the field and advise the Engineer of any discrepancy before fabricating or performing any work.
- C. The work shall include complete testing of all equipment, conduit and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment.
- D. Perform any necessary temporary work during construction.
- E. Work under this section shall conform to governing codes, ordinances and regulations of the City, County and State.
- F. The Contractor shall be responsible for any errors in fabrication, for the correct fitting, installation and erection of the various electrical systems.

1.3 SCOPE

A. Furnish and install all wiring devices and equipment, etc., unless otherwise indicated, for the complete electrical systems. It is the intent that the entire electrical work and all electrical systems shall be complete in every respect and that all outlets, receptacles, fixtures, motors, equipment, devices, etc., shown, noted, or required shall be completely connected from source of power to final connection, ready for satisfactory operation.

1.4 ELECTRICAL MATERIALS

- A. It is the intent of these specifications that the conductive materials used in the manufacture of, but not limited to, the following types of equipment be of copper construction:
 - 1. Transformers (medium voltage and low voltage)
 - 2. Electrical Power Conductors and Cables (all voltages)
 - 3. Switchgear (all voltages)
 - 4. Switchboards
 - 5. Panelboards
 - 6. Enclosed Bus Assemblies
 - 7. Power Distribution Units

1.5 CONCRETE FOUNDATION PADS

- A. The Contractor under this Division will provide all concrete curbs, bases and pads for all electrical equipment shown on the Drawings.
- B. The Contractor for this Division shall verify the sizes and locations of all supports, curbs, bases and pads prior to the pouring of same to be certain that the installed units will fit.
- C. The Contractor for this Division shall set anchor bolts in exact position prior to pouring of concrete. Sizes and locations of bolts shall be determined by the manufacturer's recommendations for the equipment served.
- D. All concrete pads shall be installed prior to setting equipment in place.

1.6 PROTECTION

A. All work, equipment and materials shall be protected at all times. All conduit openings shall be closed with caps or plugs during construction. All equipment and accessories shall be tightly covered and protected against dirt, water or other injury during the period of construction.

1.7 AUTOMATIC TEMPERATURE AND ASSOCIATED SYSTEMS CONTROLS

A. All wiring associated with the automatic temperature controls system and all associated conduit not specifically designated to be provided shall be included by others and specified under division of these specifications including motor starter interlock wiring.

1.8 EQUIPMENT FURNISHED BY OTHERS

- A. It shall be the responsibility of this Contractor to check voltage and current ratings of motors, relays, starters, switches, etc., of equipment furnished by others not connected under this section of the specifications. Nominal motor voltage ratings should be as follows:
 - 1. For connection to 480V system NEMA 460 volts
 - 2. For connection to 208V system NEMA 200 volts.
 - 3. For connection to 110V system NEMA 115 volt.
- B. Motors not conforming to these ratings shall be called to the attention of the related subcontractor and the Owner/Architect.

1.9 LIGHTING CONTROL

- A. All of the building's interior lighting is to be controlled on a programmed schedule as set in the Building Management System (BMS) software see division 23 specifications. Relays for control of these fixtures will be provided and installed by this Contractor. All low voltage control connections will be made by this Contractor. Individual space controls will operate lighting within each space during the programmed "ON" time periods.
- B. The building's exterior non-emergency lighting is also to be controlled by the BMS software. Exterior lighting connected to emergency power is to be controlled via a building mounted photocell as required by code.

1.10 EQUIPMENT INSTALLATION INSTRUCTIONS

A. Install electrical conduit, wiring and equipment in strict accordance with manufacturer's recommendations. Provide equipment accessories necessary for proper operation or recommended by the manufacturer, even if such accessories are not shown on the drawings or mentioned in the specifications.

1.11 INSTALLATION OF EQUIPMENT

A. All appliances, materials and equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturers' instructions and recommendations. All electrical connections, etc., recommended by the manufacturer or required for proper operation shall be furnished and installed complete.

1.12 EQUIPMENT CONNECTIONS

- A. Make connections to equipment furnished by others whenever such equipment is shown on any part of the drawings or mentioned in any section of the specifications.
- B. Verify equipment locations and the sizes, number, locations, and types of connections to be made before installation of any such equipment.

1.13 OPENINGS

- A. The Contractor under this Division shall be responsible for the openings he may require in floors, walls or ceilings of any type construction whether or not shown on the Architectural and/or Structural Drawings.
- B. Openings that have been shown on the Architectural and/or Structural Drawings will be provided under other Divisions; however, the responsibility for the correct size and location of such openings shall be that of the Contractor under this Division.
- C. Openings that have <u>not</u> been shown on the Architectural and/or Structural Drawings shall be provided by the Contractor under this Division as directed by the Architect.

1.14 FIRE BARRIER PENETRATION SEALS:

A. Provide seals for any opening through any walls, floors, or ceilings used as passage for electrical components such as conduit, cabling, etc.

- B. General: Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings as established by testing identical assemblies per ASTM E 814 by Underwriters' Laboratories, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction. Sealant shall provide protection equal or exceeding the fire resistance rating of fire rated walls, partitions, ceilings or floors. Use two-part or one-part sealants as required to meet required fire resistance ratings.
- C. Foamed-In-Place Fire-Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around cables, conduit, pipes and similar penetrations through walls and floors.
- D. One-Part Fire-Stopping Sealant: One-part elastomeric sealant formulated for use in a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors.
- E. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
- F. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Foamed-in-Place Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
 - b. "Pensil 851"; General Electric Co.
 - 2. One-Part Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
 - b. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
 - c. "RTV 7403"; General Electric Co.
 - d. "Fyre Putty"; Standard Oil Engineered Materials Co.
- G. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials to fill openings around mechanical and electrical services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

1.15 SINGULAR NUMBER

A. In all cases where a device or piece of equipment is referred to in the singular number (such as a light fixture, etc.), it is intended that such reference shall apply to as many such items as are required to complete the installation.

1.16 CONNECTION TO EXISTING ELECTRICAL SYSTEMS

A. The Contractor under this Division shall make all necessary electrical connections to all undisturbed existing electrical systems, as shown on the Drawings and/or required for their proper operation with the new system.

1.17 CATALOG DATA FOR THE OWNER

- A. The Contractor under this Division shall prepare loose-leaf, plastic bound brochures entitled " ECTC University Center Renovation -- Electrical Operation and Maintenance Data."
- B. Each brochure shall contain the following information:

- 1. Name and address of Consulting Engineer, Contractor and index of equipment, including vendor (name and address).
- 2. Complete brochures, descriptive data, etc., on each piece of equipment, including all reviewed and stamped shop drawings.
- 3. Complete maintenance and operating instructions and parts list, prepared by the manufacturer, on each major piece of equipment.
- 4. All wiring diagrams for equipment and systems and control schematics.
- 5. All testing results.
- C. Brochures shall be provided with tabbed index and complete Table of Contents. The page after index of each tab shall contain a summary schedule listing checks and maintenance functions required for each piece of equipment. The schedule shall be divided into daily, weekly, monthly and annual time frames as required.
- D. Brochures shall be submitted to the Architect /Engineer prior to final inspection of the building.

1.18 UTILITY SERVICE MARKERS

- A. The Contractor under this Division shall furnish and install markers for underground electrical utility services at the locations shown on the Drawings. The exact location of services shall be determined at the time of installation by triangulation.
- B. Markers shall consist of bronze plates, ground and polished, marked to identify the service. Markers shall also be stamped with arrows indicating the direction the service extends. A typical marker detail is shown on the Drawings.
- C. Markers locating services at the building shall be installed in masonry or concrete walls two feet (2') above grade. Markers locating services elsewhere on the site shall be installed in concrete walks or curbs, or in 6" x 6" steel reinforced concrete posts as detailed.
- D. One marker may be used for a maximum of two (2) common services such as primary and secondary duct banks. Where one marker is used, it shall be labeled with both services.

1.19 SPECIAL NOTE

A. All openings in electrical equipment, enclosures, cabinets, outlet and junction boxes shall be by means of standard knockouts or shall be sawed or drilled. The use of a cutting torch is prohibited.

1.20 EQUIPMENT IDENTIFICATION

- A. The Contractor for this Division shall furnish and install on all electrical equipment such as switches, starters, panelboards, etc., a nameplate giving its name and function.
- B. Nameplates shall be engraved bakelite (white letters on black background) and shall be equal to Seton Nameplate, C. H. Hanson or Identifications.

1.21 MOTOR PROTECTION INFORMATION

- A. The Contractor for this Division shall provide the following information for each motor installed on this project, regardless of the supplying Contractor:
 - 1. Motor full load current

- 2. Motor starter heater size where applicable
- 3. Fuse size
- B. This information shall be provided in tabulation form before final payment will be made to the Contractor.

1.22 EQUIVALENT MATERIAL AND EQUIPMENT

- A. The material and equipment described herein have been specified according to particular trade names or makes; however, the Contractor may offer substitute material and equipment in lieu of that specified, provided such material and equipment meet all the requirements of those specified and are approved by the Architect. /Engineer. The manufacturer's warranty covering each item of substituted material or equipment shall be equal to the warranty covering the material or equipment specified.
- B. Where equipment is approved which requires different arrangement of connections from those shown, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications, and to make all changes in the work required by the different arrangement of connections.

1.23 PERMITS, CODES AND APPROVALS

A. Permits

1. All permits necessary for the complete Electrical systems shall be obtained by the Contractor for Division 26 from the authorities governing such work. The cost of all permits shall be borne by this Contractor.

B. Codes and Rules and Regulations

1. The minimum standard for all electrical work shall be the latest revision of the National Electrical Code. Whenever and wherever state and/or local laws and/or regulations require a higher standard than the current National Electrical Code, then these laws and/or regulations shall be followed.

C. Approvals

 All work must be approved by the Architect /Engineer and the Owner before final payment will be made.

1.24 INSPECTIONS

- A. Electrical inspections will be performed throughout the course of construction by an electrical inspector from the State Fire Marshal's office. Upon project completion, and when wiring, equipment and fixtures have been installed, inspected and found to be in compliance with the National Electrical Code, the inspector will issue a certificate of compliance to the Owner. All costs incidental to the electrical inspection shall be borne by the Contractor for Division 26.
- B. The inspection shall be scheduled for rough as well as finished work. The rough inspection shall be divided into as many inspections as may become necessary to cover all roughing-in. A punch list inspection shall be scheduled with a representative of the Architect /Engineer present. The punch list inspection shall be made with panelboard and junction box covers removed.
- C. Before final acceptance, the Contractor for Division 26 shall furnish a Certificate of Final Approval by the Electrical Inspector to the Architect /Engineer and the Owner.

1.25 UL LISTINGS

A. Materials and appliances for the type for which there are Underwriters' Laboratories standard requirements listings and labels, shall have listing of Underwriters' Laboratories and shall be so labeled, or shall conform to their requirements, in which case certified statements to that effect shall be furnished by the manufacturer with a copy of an examination report by a recognized testing laboratory acceptable to the Engineer.

1.26 WORKMANSHIP

A. Competent workmen shall be employed on all phases of the work. Poor workmanship will be rejected and will constitute cause for removal of the individual performing the work.

1.27 COOPERATION WITH OTHER CONTRACTORS

- A. Each Contractor shall demand and examine all Drawings and Specifications pertaining to the construction before installing the work described and shown under these Drawings and Specifications. Each Contractor shall cooperate with all other Contractors in locating piping, conduit, openings, chases and equipment in order to avoid conflict with any other Contractor's work. All work installed above a lay-in ceiling must be coordinated and installed so there is a minimum of 4 inches between the top of the ceiling grid and the bottom of the installation.
- B. If any discrepancies occur between the accompanying Drawings and these Specifications and Drawings and Specifications covering other Contracts, each Contractor shall report such discrepancies to the Architect/Engineer far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of piping, ductwork, conduit and equipment not installed in accordance with the above instructions, and which interferes with work and equipment of other Contractors.

1.28 COORDINATION OF WORK ABOVE LAY-IN CEILING

A. All work installed above a lay-in ceiling must be coordinated and installed so there is a minimum of 4 inches between the top of the ceiling grid and the bottom of the installation. Installation shall not obstruct equipment access space or equipment removal space.

1.29 MAINTAINING EXISTING FACILITIES

- A. The existing services to and within the buildings shall be maintained during the construction without interruption, except for short periods of time that may be required to make changeover connections. The Architect /Engineer shall be notified in advance and an agreement reached as to when the connections are to be made and the length of time the particular facility will be out of service.
- B. All temporary connections that may be necessary to continue these services shall be properly made and maintained in a safe and substantial manner until the permanent facilities are activated. Upon completion, remove all temporary work, and completely restore all areas that may be affected.
- C. At any time the existing building facilities are interrupted, the Contractor shall work continuously until the permanent services are restored. The Contractor shall pay for all premium time necessary to comply with these requirements.

1.30 EXTERIOR LIGHTING

- A. This contractor shall provide temporary lighting, if required, to maintain adequate illumination for safety and security for all immediate adjacent areas to the construction site whose illumination is affected by the construction activities. Illumination requirements shall be in accordance with the recommendations as set forth by IESNA standards.
- B. Installation and operation of the temporary lighting is to be reviewed for approval by the Owner, Architect, and Engineer.

1.31 GUARANTY CERTIFICATES

A. Certificates of guaranty accompanying those items of mechanical and electrical equipment on which manufacturer's guarantees have been specified, or are normally provided, shall be completely executed by the Contractor and delivered to the Architect before completion of the work.

1.32 ALTERNATES

A. The Contractor under this Division shall refer to Division 1 of the Specifications for a complete description of the Alternates. Note that all alternates are <u>ADDITIVE</u> (DEDUCTIVE). The work detailed on the Drawings and specified are for the complete project, including all Alternates.

1.33 CLEANING

- A. After the Architect /Engineer has completed examination, the Contractor shall remove all stickers, tags, etc., and shall thoroughly clean all equipment, fixtures and materials installed under his section of the work.
- B. Surplus material, rubbish and equipment resulting from the work shall be removed from the building and premises by the respective Contractors upon completion of the work in accordance with the General Conditions.

1.34 PAINTING

- A. All exposed conduit and equipment installed under this Division, where required, shall be thoroughly cleaned and readied for painting.
- B. Painting in new areas and in existing building areas shown to be remodeled on the Architectural Drawings will be done by the Contractor under Division 9.
- C. Painting in all other areas of the existing building which have been cut and patched under this Division shall be painted to match exactly the existing adjacent surfaces. Where a match cannot be made, the entire surface shall be repainted. All painting shall be performed in strict accordance with the Specifications in Division 9. All exposed electrical work in these areas shall also be painted to match adjacent surfaces.
- D. Do not paint Cables or Wires.

1.35 WORKMANSHIP

A. Work shall be performed by mechanics skilled in their respective trades and shall present appearance typical of best trade practice. Work not installed in this manner shall be repaired, removed or replaced, or otherwise remedied as directed by the Architect/Engineer.

1.36 SUPERVISION

- A. The Contractor shall personally supervise the work or have a competent superintendent, satisfactory to the Architect/Engineer and Owner on the work at all times during progress with full authority to act.
- B. The Contractor shall lay out his work and be responsible for any necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so. Work at the site of the project shall be observed by the Architect/Engineer or his representative.
- C. Final Inspection: At the time of final inspection of the work performed under this Contract, systems shall be complete in every respect and in perfect operating condition. Surplus materials of every character resulting from work of this section shall have been removed. Sanitary sewers shall be free from sand, silt or other obstructions. Any defect discovered in the utilities subsequent to this inspection shall have been corrected.

1.37 INTERPRETATIONS

- A. Wherever in these Specifications, the term "General Contractor" is used, it shall be understood to mean the Contractor engaged in the general construction portion of the work. Similarly, wherever the "Heating and Air Conditioning Contractor," "Plumbing Contractor," "Sprinkler Contractor," or "Contractor for Division 26" is mentioned as such, it shall be understood to refer to the Contractor engaged in that particular branch of the work.
 - 1. It shall also be clearly understood that all Contractors for all branches of the work shall cooperate with each other in the coordination of the construction.
 - 2. It shall also be clearly understood that the entire construction is one responsibility and all Contractors for all branches of the work shall cooperate with each other in the coordination of the construction.

1.38 WORKING DRAWINGS

- A. Scale of drawings is approximate. Do not scale the drawings to determine locations of electrical work. Exact locations, dimensions and elevations shall be governed by field conditions. Make field measurements of building before fabricating or installing equipment or materials.
- B. Drawings are based on physical dimensions of one or more manufacturer's equipment. Other approved equipment shall be of such dimensions that it can be readily installed in available space, leaving ample clearance for proper maintenance.
- C. Intent of drawings is to show systems and sizes. Drawings do not necessarily show all required offsets. Work shall be installed to conform with space limitations. Offsets, transitions, fittings, etc., shall be provided as part of the Contract where required to attain this objective.

1.39 ELECTRICAL DRAWINGS AND SPECIFICATIONS

A. The Drawings and Specifications are intended to cover all work enumerated under the respective headings. The Drawings are diagrammatic only. The Contractor shall not take advantage of conflict or error between the Drawings and Specifications but shall request a clarification of such before making his proposal.

1.40 ARCHITECTURAL DRAWINGS AND SPECIFICATIONS

- A. The Contractor shall refer to the Architectural and Structural Drawings and Specifications for the general construction of the building, for floor and ceiling heights, for location of walls, partitions, beams, etc., and shall be guided accordingly for the setting of all sleeves, inserts and equipment.
- B. Under no circumstances shall a Contractor scale the Drawings for the location of equipment and work.

1.41 DISCREPANCIES

A. If any discrepancies occur between the accompanying Drawings and these Specifications and Drawings and Specifications covering other Contracts, report such discrepancies to the Architect/Engineer far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of piping, ductwork, conduit and equipment not installed in accordance with the above instructions, and which interferes with work and equipment of other Contractors.

1.42 RESTORATION OF SURFACES

- A. The Contractor shall restore to their original conditions all paving, curbing, sidewalks, surfaces, drainage ditches, and structures, fences, shrubs, and other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match material employed in the original construction of the item to be replaced.
- B. Unless otherwise noted in the Architectural specifications, this contractor shall seal, repair, and/or patch all openings and disturbances to the building surfaces resulting from the demolition and installation of equipment. Repairs and patching shall match the existing surfaces and be in accordance with the Architectural specifications, where applicable. See paragraph above concerning painting for additional requirements.

1.43 EXCAVATION, TRENCHING AND BACKFILLING

- A. Photographs: The contractor shall photograph all underground utilities before backfilling. Photographs shall be oriented and labeled so that the locations, all crossings and depths of the utilities can be determined from the photographs
- B. General: Excavate in accordance with requirements of Division Section "EARTHWORK" and requirements of this Section. Lay the conduit in open trench except when the Architect/Engineer gives written permission for tunneling. Open the trench sufficiently ahead of pipe laying to reveal obstructions. Maintain easy access to fire hydrants by fire fighting apparatus.
- C. Provide trench crossing as necessary to accommodate public travel.
- D. Separate Trenches: Unless otherwise shown or requested, provide separate trenches for communication and power feeders, respectively, with a minimum of 3' of undisturbed earth between trenches. Always place gas lines in a separate trench from electrical lines.

- E. Width of Trench: Excavate trenches of sufficient width for proper installation of work. When the depth of backfill over sewer pipe exceeds 10', keep the trench at the level of the top of the pipe as narrow as possible.
- F. Sheeting and Bracing: Sheet and brace trenches as necessary to protect workmen and adjacent structures. Comply with local regulations or, in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and prevent injurious caving. When ordered in writing by the Architect/ Engineer, leave sheeting in place and the Contract will be adjusted (See General Conditions): cut off such sheeting not to be removed at least 3' below finished grade.
- G. Water Removal: Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper jointing of pipes. Conduct the discharge from trench dewatering to drains or natural discharge channels.
- H. Disposition of Utilities: Observe rules and regulations governing the respective utilities in executing work under this heading. Protect active utilities from damage or remove in accordance with written instructions of the Architect/Engineer (See General Conditions). Plug, cap or remove inactive and abandoned utilities encountered in trenching operations. In absence of specific requirements, plug or cap such utility line at least 3' from utility line to be installed or as required by local regulations.
- I. Rock Excavation: Materials to be excavated shall include earth and any other material including rock encountered within the limits of trench excavation for the utilities to the depth and extent indicated on the drawings and herein specified. In case of any change ordered by the Owner or Architect/Engineer in the quantity of excavation, the contract price will be adjusted by unit price or as described under Excavation, Filling and Grading of Division Site Work of these specifications. The term "rock" as used is defined to be hard material in nature that cannot be dislodged from its bed and removed therefrom without blasting or drilling. Any other is "earth" insofar as removal of the material to be excavated is concerned.
- J. Blasting: See Division Section "EARTHWORK" to see if blasting is allowed. If blasting is allowed, obtain written approval of method from Architect/Engineer before proceeding with rock excavation.
- K. Trench Bottoms: Lay all conduit, unless otherwise noted or detailed, in undisturbed earth. Bedding shall be in place and graded before pipe is installed.
- L. Special Supports: Whenever, in the option of the Architect/Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting duct banks or other utilities and appurtenances specified in this section, provide special support as the Architect/Engineer may direct and the Contract Price will be adjusted. (See General Conditions).
- M. Tree Protection: Exercise care to protect the roots of trees to remain. Within the branch spread of such trees, perform trenching by hand. Open the trench only when the utility can be installed immediately; prune injured roots cleanly and backfill as soon as possible. Perform this work under the direction of the Architect/Engineer.
- N. Backfilling: Inspect and test piping and record locations of pipe lines and appurtenances before backfilling.
- O. Trenches Under Floor Slabs: Backfill under floor slab on grade to a point 5'-0" outside of perimeter building wall with [flowable] fill as specified in Division Section "EARTHWORK". Remove excess excavation materials from the site daily unless otherwise instructed.
- P. Trenches in Other Areas: Backfill with materials in accordance with Division Section "EARTHWORK". Compact backfill thoroughly with a heavy tamper.

Q. The Contractor, at his option, may backfill the remaining depth of the trench from 12" above top of piping to 12" below finished grade with sand, wash gravel, or fine rock chat. The remaining depth of the trench would then be backfilled as specified in the preceding specification.

1.44 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.

1.45 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

1.46 SHOP DRAWINGS

- A. Equipment and material shop drawings, catalog sheets and descriptive data shall be submitted, each with a cover sheet first listing the project name, the Contractors, Architect and Engineer, and date of submittal. Next the section of the Specifications shall be listed stating the section for which the equipment is being proposed. Next, outline equipment showing compliances to the specification requirements, such as capacities, special accessories, options, model, sizes, etc. Reverse side of cover sheet shall be left for Contractors' stamps showing review and space for Engineers' review stamp. Catalog sheets shall be marked showing equipment proposed.
- B. Materials submitted without cover sheet or Contractor review stamp and without required information will be returned to the Contractor.
- C. No roughing-in, connections, etc., shall be done until acceptable shop drawings are in the hands of the Contractors. It shall be the responsibility of the Contractor to obtain acceptable shop drawings and to make connections, etc., in the neatest and most workmanlike manner possible.
- D. Submittal data must be complete for each piece of equipment. Partial or incomplete data will not be processed.

1.47 PHASING OF WORK

A. The Contractor under this Division shall refer to Division 1, Section 01100, for a complete description of the schedule for phasing of work on this project.

1.48 STRUCTURAL RESPONSIBILITY

- A. The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing, or weakening. No structural member shall be cut or otherwise weakened in any manner without the written consent of the Architect/Engineer.
- B. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Owner or Architect/Engineer, without cost to either the Owner or the Architect/ Engineer.

1.49 HAZARDOUS MATERIALS

A. Refer to Special Conditions, Section 00801.

1.50 ASBESTOS

A. If during the course of his work the Contractor observes the existence of asbestos, or asbestos-bearing materials, the Contractor shall immediately terminate further work on the project and notify the Owner of the condition. The Owner will, after consultation with the Engineer, determine a further course of action.

1.51 OWNER INSTRUCTION

- A. Conduct a full-day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of mechanical equipment and systems. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.
- B. Engage factory-authorized service representatives for the following equipment to train Owner's maintenance personnel:
 - 1. Lighting Controls
- C. All training shall be video recorded for future use by the Owner in training new personnel.

1.52 ACCESS UNITS

- A. General: The work of this article is limited to the provisions for access through other work for access to electrical work and does not include internal access provisions (within the electrical work). In general, and where possible, furnish or furnish-and-mount required access units in other trades' work prior to their work, so that cutting and patching for the subsequent installation of such access units will not be required. In occupied spaces, provide finished access units of the maximum concealment type, including locks where appropriate, and matching access units provided in the same expanse of finish (for non-mechanical access, if any).
- B. The scope of access units to be furnished or provided as electrical work includes those units indicated on the electrical drawings or specified in Division 26 sections, and those additional units required for adequate access to electrical work and not shown or specified individually.
- C. Access Doors: Standard welded-steel construction, 16-gage frames and 14 gage door panels, 175 degree concealed spring hinges, rust-inhibitive prime coat, flush cam lock (for screw-driver operation where keyed

- lock is not required), recessed to receive applied finish where applicable (such as in concealed spline ceilings).
- D. Removable Access Plates: Where only hand access is sufficient, provide removable plate-type access unit, or minimum size which will facilitate the required access. Provide units of the type, style, design, material and finish appropriate for the location and exposure in each instance. In exposed surfaces of occupied spaces provide round plate units, flush floor units and frameless low-profile wall units, primed-for-paint in painted surfaces and polished chrome or stainless-steel finish in other surfaces.
- E. Access Thru Fire Rated Walls or Ceilings: Where access doors or plates are required in fire rated partitions or ceilings, provide U.L. listed "B" Label doors or plates rated for 1-1/2 hours. Furnish doors with automatic closers and key operated latches that latch automatically when door closes.

1.53 OWNER OCCUPANCY

A. Full Owner Occupancy: The Owner will occupy the site and building surrounding construction area during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work to minimize interference with the Owner's operations. Perform portions of work on premium time if required to do so by the Owner.

1.54 PROVIDING AIRTIGHT SPACES

- A. In rooms where room walls extend above ceiling to the floor or roof above, caulk around all new and existing penetrations through walls, ceilings, floors and/or roofs to make completely airtight rooms. Seal penetrations both above and below suspended ceilings. Seal any openings left by removal of any existing or new work. Caulking used shall be the same type as specified in the Architectural Specifications.
- B. Patch around rough openings of penetrations to form a tight fit before caulking.

1.55 LINTELS:

- A. General: Provide lintels for penetration of electrical systems through masonry walls if not provided elsewhere in these specifications. Lintels shall be type and size required to span the required openings.
- B. Lintels will not be required for openings 16 inches length or less.

1.56 BUILDING COMMISSIONING RATING

- A. A Commissioning Agent will be involved during the construction phase of the project. The contractor providing work under this division will be required to attend regular commissioning meetings, to complete commissioning forms, to provide information to the Commissioning Agent, and to coordinate with the Commissioning Agent. The Commissioning Agent will provide punch lists during the construction phase and the contractor providing work under this division will make corrections, as required.
- B. Refer to front end specifications for additional requirements.

1.57 CIRCUIT HOME RUNS

A. All home runs for electrical feeders are to be installed as indicated on the drawings with respect to circuit groupings and home run location.

B. Home run circuits may not be consolidated into larger conduits without the express written approval of the Engineer.

PART 2 - PRODUCTS

2.1 Not Applicable

PART 3 - EXECUTION

3.1 Not Applicable

END OF SECTION 260000

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 REVIT

- A. The plans, sections and risers were made with REVIT. This program has some limitations on the types of fittings, taps, accessories... that can be show. The contractor should review the specifications and details for the proper type of fittings, taps, accessories... because what is shown on the plans may be the "closest" available within the limitations of REVIT and not exactly what is required by the contract specifications and details.
- B. Mounting heights may have been modified to show elements on the correct floor plan for bidding. Coordinate with the architect and engineer if it is not clear.
- C. Components may be orientated for clarity. Actual components shall be orientated as required by specifications, service requirements or manufacturers recommendations.
- D. All pathway installations required for Divisions 27 and 28 are to be installed by the Division 26 contractor.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Common electrical installation requirements.

1.4 **DEFINITIONS**

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.5 SUBMITTALS

A. Product Data: For sleeve seals.

1.6 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

- 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
- 3. To allow right of way for piping and conduit installed at required slope.
- 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 CONDUITS IN EXPOSED CEILING AREAS

A. Where overhead conduits will be exposed in areas with no ceilings, conduits shall be installed parallel/perpendicular to the building structure. Conduits shall be concealed from view as much as practical behind structural members while maintaining accessibility. Conduits shall be grouped together in an organized fashion to minimize space occupied by conduits. Conduits shall be held tight to bottom of slab above to maximize vertical space below conduits. Conduits shall be concealed above adjacent soffits or accessible ceilings, where possible.

END OF SECTION 260500

SECTION 260513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.

1.03 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.04 SUBMITTALS

- A. Product Data: For each type of cable indicated. Include splices and terminations for cables and cable accessories.
- B. Qualification Data: For Installer and testing agency.
- C. Source quality-control test reports.
- D. Field quality-control test reports.

1.05 QUALITY ASSURANCE

- A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer and having AVO certification, to install, splice, and terminate medium-voltage cable. These qualifications must be submitted to the Engineer for review and approval prior to commencing any medium voltage work.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with IEEE C2 and NFPA 70.

1.06 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

- Notify Construction Manager no fewer than fourteen days in advance of proposed interruption of electric service.
- 2. Do not proceed with interruption of electric service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cables:
 - a. General Cable Technologies Corporation Uni-shield cable.
 - b. Okonite Company (The).
 - c. Southwire Company.
 - 2. Cable Splicing and Terminating Products and Accessories:
 - a. Raychem Corp.; Telephone Energy and Industrial Division; Tyco International Ltd.
 - b. RTE Components; Cooper Power Systems, Inc.
 - c. Thomas & Betts Corporation/Elastimold.
 - d. 3M; Electrical Products Division.
 - 3. Fault Indicators:
 - a. E.O. Schweitzer Manufacturing

2.02 CABLES

- A. Cable Type: MV105.
- B. Comply with UL 1072, AEIC CS 8, ICEA S-93-639/NEMA WC 74, and ICEA S-97-682.
- C. Conductor Stranding: Compact round, concentric lay, Class B.
- D. Conductor Insulation: Ethylene-propylene rubber.
 - 1. Voltage Rating: 15kV
 - 2. Insulation Thickness: 133 percent insulation level
- E. Shielding: Copper tape, helically applied over semiconducting insulation shield with minimum 25% overlap.
- F. Cable Jacket: Chlorosulfonated polyethylene.

2.03 SPLICE KITS

- A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.
- B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.
 - Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket or dead break cable terminators.

2.04 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer non-tracking tubes; multiple, molded, non-tracking skirt modules; and compression-type connector.

2.05 SEPARABLE INSULATED CONNECTORS

- A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
- C. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for deenergized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

2.06 FAULT INDICATORS

- A. Indicators: Automatic reset fault indicator, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.
- B. On each phase of all utilized circuits of a new or existing switch, with a single display 3-phase fault indicator to be mounted on the switch operator side of the switch. The fault indicator shall be rated at 1200 amps with inrush restraint, current reset and snap action clamp for cable with O.D. of 1.6". The approved fault indicator catalog number is 1CRD1200SIR. The fault indicator shall be installed and positioned to be read easily at safe distance.

2.07 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 before shipping.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install cables according to IEEE 576.
- B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches (1200 to 1800 mm) on the pull rope.
 - 1. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.
- C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.

- F. Install cable splices at pull points and elsewhere as indicated; use standard kits.
- G. Install terminations at ends of conductors.
- H. Install separable insulated-connector components as follows:
 - Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
 - 2. Portable Feed-Through Accessory: Three.
 - 3. Standoff Insulator: Three.
- I. Install fault indicators on each phase where indicated.
- J. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.
- K. Identify cables according to Division 26 Section "Identification for Electrical Systems."

3.02 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Utilize testing procedure described in the University of Kentucky construction Standards.
- C. All proper testing hardware and equipment shall be onsite ready for use prior to commencement of the testing. This includes
 - 1. Properly calibrated test equipment for the range of testing voltages to be used.
 - 2. Proper insulating plugs to insulate exposed ends of cable where possible.
 - 3. Proper connecting hardware to facilitate connection of testing leads and equipment.
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
 - 2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Hipot Testing
 - a. Use equipment made by one of the following and abide by their operating rules for their respective equipment:

Associated Research, Inc. J.G. Biddle Company Hipotronic, Inc. Von Corporation

- b. Clear cable of all equipment, switchgear, etc. For elbows, install insulation plugs. On cable end, insulate by high voltage taping, insulating jar or plastic. All terminations and splices shall be complete and properly grounded. All adjacent equipment shall be grounded.
- c. A sphere gap in parallel with the 100,000 volt D.C. "Hipot" tester shall be calibrated for sparkover at 70 KV D.C.
- d. The direct current test voltage shall be applied in increments of 5 KV and shall be left at that step for one minute. Saturate cable for 15 minutes at test voltage in 5 below.
- e. Test:
 - 15 KV cables with open terminations at 65 KV D.C.
 - 15 KV cables with elbow terminations at 54 KV D.C.

- f. Record: Leakage current at each step and at end of saturation time.
- g. Acceptance: The above procedure with less than 100 microamperes of current registered. Most cables shall read less than 100 microamperes.
- h. Proof test on existing cable at 35 KV for both 15 KV cables with open terminations and 15 KV cables with elbow terminations (as above).
- i. After test (in order listed):

Turn tester power off

Discharge tester and cable through a resistive discharge device (8 MEGOHM discharge stick).

Ground cable through a grounding means (#12 AWG THW wire to ground).

Disconnect tester.

j. For Safety:

Wear high voltage gloves at all times Treat cable and tester as high voltage at all times Remember, D.C. static charges can be harmful

- k. All tests must be made in the presence of the job Engineer and shall be recorded on a form sheet signed by the person performing the test and dated. A copy shall be submitted to the Engineer.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260513

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Copper building wire rated 600 V or less.
- 2. Fire-alarm wire and cable.
- 3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

- 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
- 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
- 3. Section 271300 "Communications Backbone Cabling" for twisted pair cabling used for data circuits.
- 4. Section 271500 "Communications Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>General Cable Technologies Corporation.</u>
 - 2. Okonite Company (The).
 - 3. Southwire Company.

C. Standards:

- Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- 2. RoHS compliant.
- 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 2. Type THHN and Type THWN-2: Comply with UL 83.
- F. Shield:
 - 1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 FIRE-ALARM WIRE AND CABLE

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Allied Wire & Cable Inc</u>.
 - 2. <u>CommScope, Inc.</u>
 - 3. Genesis Cable Products; Honeywell International, Inc.
 - 4. Radix Wire.
- B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

- 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
- 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M Electrical Products.
 - 2. <u>Appleton O-Z/Gedney; Emerson Electric Co., Automation Solutions.</u>
 - 3. Hubbell Incorporated, Power Systems.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed below Slabs-on-Grade and Underground: Type THHN/THWN-2, single conductors in raceway.

- E. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed below Slabs-on-Grade and Underground: Type THHN/THWN-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. VFC Output Circuits: Type TC-ER cable with braided shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRING

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

- 1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
- 2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
- 3. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as fire alarm signaling line circuits.

- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
- D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. ERICO; a brand of nVent.
 - 2. <u>Harger Lightning & Grounding.</u>
 - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 4. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:

- 1. Solid Conductors: ASTM B 3.
- 2. Stranded Conductors: ASTM B 8.
- 3. Tinned Conductors: ASTM B 33.
- 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
- 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
- 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, copper lugs. Rated for 600 A.
- M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- N. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8 by 96 inches (16 by 2400 mm).

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

D. <u>Use exothermic welds for all below-grade connections.</u>

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

- 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
- 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- G. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Steel slotted support systems.
- 2. Conduit and cable support devices.
- 3. Support for conductors in vertical conduit.
- 4. Structural steel for fabricated supports and restraints.
- 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
- 6. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Atkore International (Unistrut).
 - b. Eaton (B-line).
 - c. GS Metals Corp.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 4. Channel Width: 1-5/8 inches (41.25 mm).
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

- a. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) <u>Eaton (B-line)</u>.
 - 2) <u>Hilti, Inc</u>.
 - 3) <u>ITW Ramset/Red Head; Illinois Tool Works, Inc.</u>
 - 4) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M,Grade A325 (Grade A325M).
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 102.
 - 4. NECA 105.
 - 5. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Republic Conduit.
 - b. Western Tube and Conduit Corporation.
 - c. Wheatland Tube Company.
 - d. Allied Tube & Conduit
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- 3. GRC: Comply with ANSI C80.1 and UL 6.
- 4. EMT: Comply with ANSI C80.3 and UL 797.
- 5. FMC: Comply with UL 1; zinc-coated steel.
- 6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Republic Conduit.
 - b. Western Tube and Conduit Corporation.
 - c. Wheatland Tube Company.
 - d. Allied Tube & Conduit.
- 2. Comply with NEMA FB 1 and UL 514B.
- 3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 4. Fittings, General: Listed and labeled for type of conduit, location, and use.
- 5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
- 6. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression type for Conduit sizes 2-1/2" and smaller, set-screw or compression type for conduit sizes larger than 2-1/2".
- 7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- 8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cantex Inc.
 - b. <u>Champion Fiberglass, Inc.</u>
 - c. <u>Electri-Flex Company</u>.
 - d. Allied Tube & Conduit.
- 2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 3. Fiberglass:
 - a. Comply with NEMA TC 14.
 - b. Comply with UL 2515 for aboveground raceways.
 - c. Comply with UL 2420 for belowground raceways.

- 4. ENT: Comply with NEMA TC 13 and UL 1653.
- 5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- 6. LFNC: Comply with UL 1660.
- 7. Rigid HDPE: Comply with UL 651A.
- 8. Continuous HDPE: Comply with UL 651A.
- 9. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

- 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. <u>Cantex Inc.</u>
 - b. Champion Fiberglass, Inc.
 - c. Condux International, Inc.
 - d. Allied Tube & Conduit.
- 2. Fittings, General: Listed and labeled for type of conduit, location, and use.
- 3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
- 4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Eaton (B-line)</u>.
 - 2. MonoSystems, Inc.
 - 3. <u>Schneider Electric USA (Square D)</u>.
 - 4. Wiegmann; Hubbell Incorporated, Commercial and Industrial.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. MonoSystems, Inc.
 - b. Wiremold; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton (Crouse-Hinds).
 - 2. Hubbell Incorporated.
 - 3. Wiremold; Legrand North America, LLC.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- J. Gangable boxes are allowed.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:

- 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- 2. Hinged door in front cover with flush latch and concealed hinge.
- 3. Key latch to match panelboards.
- 4. Metal barriers to separate wiring of different systems and voltage.
- 5. Accessory feet where required for freestanding equipment.
- 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): *LFMC*.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of
 conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and
 fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of
 coats recommended by manufacturer.
 - 3. EMT: Use Compression type for Conduit sizes 2-1/2" and smaller, set-screw or compression type for conduit sizes larger than 2-1/2". Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways shall NOT be Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Z. Expansion-Joint Fittings:

- 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
- 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
- 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
- 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
- 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches (915 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
 - 2. Rigid nonmetallic duct.
 - 3. Duct accessories.
 - 4. Polymer concrete handholes and boxes with polymer concrete cover.

1.3 **DEFINITIONS**

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including spacers and miscellaneous components.
 - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Include accessories for manholes, handholes, boxes.
 - 4. Include underground-line warning tape.
- B. Shop Drawings:
 - 1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.

- b. Include duct entry provisions, including locations and duct sizes.
- c. Include cover design.
- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than 14 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.3 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.4 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

- B. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Armoreast Products Company; brand of Hubbell Utility Solutions; Hubbell Incorporated.
 - 2. Oldcastle Infrastructure Inc.; CRH Americas.
 - 3. Quazite; brand of Hubbell Utility Solutions; Hubbell Incorporated.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have closed bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, as indicated for each service. "ELECTRIC" for power side; "LOW VOLTAGE" for the lighting control side.
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Nordic Fiberglass, Inc.
 - b. <u>Oldcastle Precast, Inc.</u>
 - c. Quazite; Hubbell Incorporated, Power Systems.
 - 2. Standard: Comply with SCTE 77.
 - 3. Color of Frame and Cover: Green.
 - 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 - 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

- 7. Cover Legend: Molded lettering, "ELECTRIC.".
- 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Lighting Feeders 600 V and Less: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- C. Stub-ups: Concrete-encased GRC.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.

- Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
- 3. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 36 inches (914.4 mm), both horizontally and vertically, at other locations unless otherwise indicated.
 - 1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.

- 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell, without reducing duct slope and without forming a trap in the line.
- 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch (19 mm).
- 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to terminator spacing 10 feet (3 m) from the terminator, without reducing duct line slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch (19 mm).
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- K. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.
- L. Concrete-Encased Ducts and Duct Bank:
 - Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
 - 2. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
 - 3. Depth: Install so top of duct envelope is at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
 - 4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - 5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - 6. Minimum Space between Duct: 3 inches (75 mm) between edge of duct and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and communications ducts.
 - 7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

- 8. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
- 9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- 10. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches (50 mm) between duct of like services, and 4 inches (100 mm) between power and communications ducts.
- 11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions or use other specific measures to prevent expansioncontraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (15-mm) reinforcing-rod dowels extending a minimum of 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
- 12. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
- 13. Apply a powdered concrete dye to the top of the concrete encasement to achieve a uniform color across the entire top of the encasement. Use red dye for electric ductbanks and yellow dye for telecommunications ductbanks.

M. Direct-Buried Duct and Duct Bank:

- 1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
- 2. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
- 3. Depth: Install top of duct at least 24 inches (609 mm) below finished grade unless otherwise indicated.
- 4. Set elevation of bottom of duct bank below frost line.
- 5. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
- 6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- 7. Install duct with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and communications duct.
- 8. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

- 9. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
- N. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all concrete-encased duct and duct banks and approximately 12 inches (300 mm) below grade. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- E. Form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.

- 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
 - 1. Sweep floor, removing dirt and debris.
 - 2. Remove foreign material.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
- 2. Labels.
- 3. Bands and tubes.
- 4. Ceiling Identification Discs
- 5. Tapes and stencils.
- 6. Tags.
- 7. Signs.
- 8. Cable ties.
- 9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White or gray.
 - 5. Color for Equipment Grounds: Green.
 - 6. Colors for Isolated Grounds: Green with white stripe.
- B. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- C. Warning labels and signs shall include, but are not limited to, the following legends:
 - Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
- D. Equipment Identification Labels:
 - 1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. emedco.
 - c. <u>HellermannTyton</u>.
 - d. Marking Services, Inc.

e. Panduit Corp.

2.4 MARKERS FOR IDENTIFYING EQUIPMENT ABOVE CEILINGS:

- A. Provide manufacturer's standard laminated plastic, color-coded equipment markers for identifying type and location of electrical equipment above suspended ceilings. Provide markers with pressure adhesive and engraved as scheduled in this section. Markers shall be narrow enough to fit on exposed ceiling grid and long enough to accommodate specified engraving. Install on ceiling grid closest to equipment above ceiling.
- B. Underground-Line Warning Tape:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Brady Corporation</u>.
 - b. Ideal Industries, Inc.
 - c. Marking Services, Inc.
 - 2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE".

2.5 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Brady Corporation</u>.
 - b. emedco.
 - c. Marking Services, Inc.

2.6 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. emedco.
 - c. Marking Services, Inc.
 - 2. Engraved legend.

3. Thickness:

- a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
- b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
- c. Engraved legend with white letters on a dark gray background.
- d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>HellermannTyton</u>.
 - 2. Ideal Industries, Inc.
 - 3. Marking Services, Inc.
 - 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- O. Underground Line Warning Tape:

- 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench [or concrete envelope]exceeds 16 inches (400 mm) overall.
- 2. Limit use of underground-line warning tape to direct-buried cables.
- 3. Install underground-line warning tape for direct-buried cables and cables in raceways.

P. Metal Tags:

- 1. Place in a location with high visibility and accessibility.
- 2. Secure using [general-purpose] [UV-stabilized] [plenum-rated] cable ties.
- Q. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- R. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. In Spaces Handling Environmental Air: Plenum rated.

3.3 ELECTRICAL EQUIPMENT IDENTIFICATION ABOVE CEILING:

A. Attach Seton-Ply Discs to ceiling grid under equipment or to access doors in non-accessible ceilings as follows:

| | | | Background | Lettering |
|----|--------------------------|-----------------|------------|--------------|
| | <u>Equipment</u> | Engraved | Color | <u>Color</u> |
| 1. | Lighting Control Device | LCD | Green | White |
| 2. | Emergency Transfer Relay | ETR | Green | White |
| 3. | Disconnect | DSC | Purple | White |
| 4. | Power Supply | PS | Purple | White |
| 5. | Duct Smoke Detector | DSD | Orange | White |
| 6. | Data Port | DP | Grey | White |
| 7. | 4" Comm Conduit End | CMC | Grey | White |

B. Disconnect Switches serving equipment above ceiling (such as HVAC equipment that is already tagged) do not require identification discs.

3.4 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- D. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- E. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- F. Arc Flash Warning Labeling: Self-adhesive labels.
- G. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- H. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- I. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power-transfer equipment.
 - p. Contactors
 - q. Remote-controlled switches, dimmer modules, and control devices.
 - r. Battery-inverter units.
 - s. Battery racks.
 - t. Power-generating units.
 - u. Monitoring and control equipment.

v. UPS equipment.

3.5 PROJECT SPECIFIC REQUIREMENTS

- A. All wiring device covers shall be labeled to indicated panel and circuit number. Labels shall be machine printed, self-adhesive labels, typed and laminated. The inside of the box shall be labeled with permanent marker.
- B. Label all circuits entering each lighting control relay with a permanent marker on the door of the relay cabinet/enclosure.

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 **DEFINITIONS**

- A. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

- 1. For computer software program to be used for studies.
- 2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Short-circuit study input data, including completed computer program input data sheets.
 - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

- Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
- 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power Systems Analysis Software Developer.
 - 2. For Power System Analysis Specialist.
 - 3. For Field Adjusting Agency.
- B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
 - 2. The following are from the Short-Circuit Study Report:
 - a. Final one-line diagram.
 - b. Final Short-Circuit Study Report.
 - c. Short-circuit study data files.
 - d. Power system data.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
 - Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform shortcircuit studies
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>EDSA Micro Corporation</u>.
 - 2. Power Analytics, Corporation.
 - 3. <u>SKM Systems Analysis, Inc.</u>
- B. Comply with IEEE 399 and IEEE 551.
 - 1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 - 6. Derating factors and environmental conditions.
 - 7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
 - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.

- 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:
 - 1. One-line diagram of system being studied.
 - 2. Power sources available.
 - 3. Manufacturer, model, and interrupting rating of protective devices.
 - 4. Conductors.
 - 5. Transformer data.
- G. Short-Circuit Study Output Reports:
 - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
 - 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
 - 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

- Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.
- 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
 - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 - 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 - 7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 - 9. Motor horsepower and NEMA MG 1 code letter designation.
 - 10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 - 11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

- G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- I. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 - COORDINATION STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.

1.3 **DEFINITIONS**

- A. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

- 1. For computer software program to be used for studies.
- 2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Coordination-study input data, including completed computer program input data sheets.

- b. Study and equipment evaluation reports.
- 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power System Analysis Software Developer.
 - 2. For Power Systems Analysis Specialist.
 - 3. For Field Adjusting Agency.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
 - 1. The following are from the Coordination Study Report:
 - a. Final one-line diagram.
 - b. Final protective device coordination study.
 - c. Coordination study data files.
 - d. List of all protective device settings.
 - e. Time-current coordination curves.
 - f. Power system data.

1.7 **QUALITY ASSURANCE**

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
 - 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. EDSA Micro Corporation.
 - 2. Power Analytics, Corporation.
 - 3. <u>SKM Systems Analysis, Inc.</u>
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, timecurrent coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.

- 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- 6. Any revisions to electrical equipment required by the study.
- 7. Study Input Data: As described in "Power System Data" Article.
 - Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
 - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, and ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 - 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 - 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 - 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.

- 5. Maintain selectivity for tripping currents caused by overloads.
- 6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
- 7. Provide adequate time margins between device characteristics such that selective operation is achieved.
- 8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
 - 1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus (three phase and line to ground).
 - 5. Full-load current of all loads.
 - 6. Voltage level at each bus.
 - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 - 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 - 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

- 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
- 12. Maximum demands from service meters.
- 13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
- 14. Motor horsepower and NEMA MG 1 code letter designation.
- 15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
- 16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
- 17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
 - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

- G. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

- 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
- 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.
- K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

M. Protective Device Evaluation:

- 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
- 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
- 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
- 4. Include in the report identification of any protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
 - 1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
 - 2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.

3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:
 - 1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
 - 2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
 - 3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573.16

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 **DEFINITIONS**

- A. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
 - 3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from

Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power Systems Analysis Software Developer.
 - 2. For Power System Analysis Specialist.
 - 3. For Field Adjusting Agency.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
 - 2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 **QUALITY ASSURANCE**

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arcflash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:

- 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
- 2. A member company of NETA.
- 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. EDSA Micro Corporation.
 - 2. Power Analytics, Corporation.
 - 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
 - Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.

- d. No AC Decrement (NACD) ratio.
- e. Equivalent impedance.
- f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
- g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.
 - 7. Working distance.
 - 8. Incident energy.
 - 9. Hazard risk category.
 - 10. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
- B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 - 4. Arc flash PPE category.
 - 5. Required minimum arc rating of PPE in Cal/cm squared.
 - 6. Available incident energy.
 - 7. Working distance.
 - 8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
 - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
 - 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
 - Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
 - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
 - 4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arcflash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

- 1. When the circuit breaker is in a separate enclosure.
- 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
 - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance or available short circuit current at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus (three phase and line to ground).
 - 5. Full-load current of all loads.
 - 6. Voltage level at each bus.
 - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 - 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 - 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 - 12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
 - 13. Motor horsepower and NEMA MG 1 code letter designation.
 - 14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 - 15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

- A. Apply arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 - 1. Low-voltage switchboard.
 - 2. Switchgear.
 - 3. Low voltage transformers.
 - 4. Panelboard and safety switch over 250 V.
 - 5. Applicable panelboard and safety switch under 250 V.
 - 6. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
 - 1. Indicate arc-flash energy.
 - 2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 260573.19

SECTION 260943 - RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The lighting control system specified in this section shall provide time-based, sensor-based (occupancy), and manual lighting control.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- C. The system architecture shall provide stand-alone groups (rooms) of devices to function in a default capacity even if network connectivity to the greater system is lost. The network shall allow for remote troubleshooting and reporting as well as some higher level functionality.
- D. The system shall not require any centrally hardwired switching equipment.
- E. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.
- F. Graphical floor plan software shall be provided allowing the owner to see devices in specific rooms and by clicking on the symbol with a mouse shall be able to see status, make device adjustments, modify schedules, over-ride, and/or disable devices. The software shall also provide a reporting tool that indicates what savings have been accomplished by use of each technology used in a space over a specified time (Occupancy sensing, daylight harvesting, time of day, etc.)

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. IP: Internet protocol.
- C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- D. PC: Personal computer; sometimes plural as "PCs."
- E. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panels for installation according to NECA 407.

1.6 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
- B. Coordinate lighting controls with BAS either through IP based intercommunication of system or hardwired auxiliary relay outputs.
- C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.7 WARRANTY

A. All devices in lighting control system shall have a 5 year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. This specification is based on the nLight® Network Control System from Sensor Switch, an Acuity Brands Company (800-727-7483, www.sensorswitch.com). Equivalents by Lutron or Watt Stopper.

2.2 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section)

- D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and posses RJ-45 style connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- K. System shall have one or more primary wall mounted network control "gateway" devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- L. System shall use "bridge" devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
- M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the "bridge" devices and all cabling that connects zones to bridge devices.
- N. WiFi enabled devices shall be able to detect when WiFi network is down and revert to a user directed default state.
- O. WiFi-enabled devices shall be capable of current monitoring
- P. WiFi-enabled devices shall utilize WPA2 AES encryption
- Q. WiFi-enabled devices shall be able to connect to 802.11b/g/n WiFi networks
- R. WiFi-enabled devices shall have at least one local RJ-45 port for communicating with nonWiFi-enabled system devices
- S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.
- T. Individual lighting zones shall be capable of being segmented into several "local" channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- U. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.

- V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
- W. A taskbar style desktop application shall be available for personal lighting control.
- X. An application that runs on "smart" handheld devices (such as an Apple® IPhone®) shall be available for personal lighting control.
- Y. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
- Z. Control software shall enable integration with a BMS via BACnet IP.
- AA. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Control Module (Gateway)
 - 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
 - 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
 - 3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
 - 4. Device shall automatically detect all devices downstream of it.
 - 5. Device shall have a standard and astronomical internal time clock.
 - 6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
 - 7. Device shall have a USB port
 - 8. Each control gateway device shall be capable of linking 1500 devices to the management software.
 - 9. Device shall be capable of using a dedicated or DHCP assigned IP address.

B. Networked System Occupancy Sensors

- 1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
- 2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.

- 3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
- 4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
- 5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
- 6. Sensors shall have a 2nd auxiliary relay for connection and integration with BMS.
- 7. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
- 8. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
- 9. Sensors shall be available in multiple lens options which are customized for specific applications.
- 10. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- 11. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
- 12. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
- 13. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
- 14. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
- 15. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
- 16. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
- 17. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
- 18. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.

- 19. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
- 20. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls
- 21. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
- 22. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
- 23. Embedded sensors shall have an optional photocell
- 24. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
- 25. Fixture mount sensors shall be capable of powering themselves via a line power feed.
- 26. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
- 27. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).
- 28. System shall have WiFi enabled fixture mountable sensors available.
- 29. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output
- C. Networked System Daylight (Photocell and or Dimming) Sensors
 - 1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 - 2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 - 3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
 - 4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
 - 5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
 - 6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
 - 7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
 - 8. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall

- be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and $^{1}\!\!/_{4}$ HP motor load. Relays shall be dry contacts.
- 9. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.

D. Networked System Power (Relay) Packs

- 1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
- 2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
- 3. All devices shall have two RJ-45 ports.
- 4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
- 5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- 6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- 7. Power Packs and Power Supplies shall be available that are WiFi enabled.
- 8. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
- 9. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
- 10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
- 11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
- 12. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
- 13. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.

- 14. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.
- 15. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
- 16. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
- 17. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
- 18. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

E. Networked System Relay & Dimming Panels

- 1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
- 2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
- 3. Panel shall provide one 0-10VDC dimming output paired with each relay.
- 4. Panel shall power itself from an integrated 120/277 VAC supply.
- 5. Panel shall be capable of operating as either two networked devices or as one.
- 6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
- 7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection

F. Networked Auxiliary Input / Output (I/O) Devices

- 1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
- 2. Devices shall have two RJ-45 ports
- 3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- 4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
- 5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
- 6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output

- 7. Specific I/O devices shall sense state of low voltage outdoor photocells
- 8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
- 9. Specific I/O devices shall sense.

G. Networked LED Luminaires

- 1. Networked LED luminaire shall have a mechanically integrated control device
- 2. Networked LED luminaire shall have two RJ-45 ports
- 3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
- 4. Networked LED luminaire shall provide low voltage power to other networked control devices
- 5. System shall be able to turn on/off LED luminaire without using a relay
- 6. System shall be able to maintain constant lumen output over the specified life of the LED luminarie (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
- 7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).

H. Networked System Wall Switches & Dimmers

- 1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
- 2. Devices shall be available with zero or one integrated Class 1 switching relay.
- 3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- 4. All sensors shall have two RJ-45 ports.
- 5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
- 6. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
- 7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
- 8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
- 9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
- 10. Devices with mechanical push-buttons shall be made available with custom button labeling

11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

I. Networked System Graphic Wall Station

- 1. Device shall have a 3.5" full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
- 2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
- 3. Device shall enable user supplied .jpg screen saver image to be uploaded.
- 4. Device shall surface mount to single-gang switch box
- 5. Device shall have a micro-USB style connector for local computer connectivity.
- 6. Device shall have two RJ-45 ports for communication

J. Networked System Scene Controllers

- 1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
- 2. Device shall recess into single-gang switch box and fit a standard GFI opening.
- 3. Devices shall provide LED user feedback.
- 4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- 5. All sensors shall have two RJ-45 ports.
- 6. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
- 7. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
- 8. Device shall have LEDs indicating current selection.

K. Communication Bridges

- 1. Device shall surface mount to a standard 4" x 4" square junction box.
- 2. Device shall have 8 RJ-45 ports.
- 3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.

- 4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
- 5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.4 LIGHTING CONTROL PROFILES

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5 MANAGEMENT SOFTWARE

- A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a User Name and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.
- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.6 BMS COMPATIBILITY

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.
- B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.
- C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.7 SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

- A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.
- B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.
- C. An "Energy Scorecard" shall be display that shows calculated energy savings in dollars, KWHr, or CO2.
- D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
- E. Energy savings data shall be calculated for the system as a whole or for individual zones.
- F. A time scaled graph showing all relay transitions shall be presented.
- G. A time scaled graph showing a zones occupancy time delay shall be presented
- H. A time scaled graph showing the total light level shall be presented.
- I. User shall be able to customize the baseline run-time hours for a space.
- J. User shall be able to customize up to four time-of-day billing rates and schedules.
- K. Data shall be made available via a .CSV file

2.8 START-UP & SUPPORT FEATURES

- A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
- B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
- C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
- D. All system devices shall be capable of being given user defined names.
- E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- F. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels according to NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING INSTALLATION

- A. Retain one of two "Wiring Method" paragraphs below and coordinate with Drawings. Delete both if wiring methods for system are indicated on Drawings.
- B. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 PANEL INSTALLATION

- A. Comply with NECA 1.
- B. Install panels and accessories according to NECA 407.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Mount panels above accessible ceiling. Coordinate location of panel so that they are accessible from a standard ladder.
- E. Mount panel cabinet plumb and rigid without distortion of box.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Acceptance Testing Preparation:
 - 1. Test continuity of each circuit.
- D. Lighting control panel will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.
- B. Required factory-trained personnel site visits:
 - 1. Pre-installation: The system shall be provided with visits from factory trained technician(s) for a pre-installation visit with the contractor prior to system installation.
 - 2. Commissioning and Programming: A second visit shall be included for commissioning and programming of the system including testing of switches and sensors.
 - 3. Owner Training: A third visit shall be provided for owner training after the owner has occupied the building. Minimum four hour training to be video recorded.
 - 4. Owner Re-Training and System Adjustment: A fourth visit 6 months after the owner has occupied the building shall be provided to tweak the system for occupant preferences and for additional training.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 PROJECT SPECIFIC REQUIREMENTS

A. All Category 5, 6, and 6A cabling installed under these specifications shall meet the installation requirements of horizontal data cabling including labeling, termination, and testing requirements.

END OF SECTION 260943

SECTION 261219 - PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pad-mounted, liquid-filled, medium-voltage distribution transformers, with primary and secondary bushings within or without air-terminal enclosures.

1.3 **DEFINITIONS**

- A. BIL: Basic Impulse Insulation Level.
- B. Bushing: An insulating structure including a central conductor, or providing a central passage for a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.
- C. Bushing Elbow: An insulated device used to connect insulated conductors to separable insulated connectors on dead-front, pad-mounted transformers and to provide a fully insulated connection. This is also called an "elbow connector."
- D. Bushing Insert: That component of a separable insulated connector that is inserted into a bushing well to complete a dead-front, load break or non-load break, separable insulated connector (bushing).
- E. Bushing Well: A component of a separable insulated connector, either permanently welded or clamped to an enclosure wall or barrier, having a cavity that receives a replaceable component (bushing insert) to complete the separable insulated connector (bushing).
- F. Elbow Connector: See "bushing elbow" above.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For pad-mounted, liquid-filled, medium-voltage transformers.
 - 1. Include plans and elevations showing major components and features.
 - a. Include a plan view and cross section of equipment base, showing clearances, required workspace, and locations of penetrations for grounding and conduits.

- 2. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include single-line diagram.
- 4. Include list of materials.
- 5. Include nameplate data.
- 6. Manufacturer's published time-current curves of the transformer high-voltage fuses, with transformer damage curve, inrush curve, and thru fault current indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 - 1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement.
- B. Qualification Data: For testing agency.
- C. Product Certificates: For transformers, signed by product manufacturer.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2.
- C. Comply with IEEE C57.12.00.

2.2 PERFORMANCE REQUIREMENTS

A. Windings Material: Copper.

- B. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, fully shielded, separable-elbow type, suitable for plugging into the inserts provided in the high-voltage section of the transformer. Connected in each phase of incoming circuit and ahead of any disconnecting device.
- C. Winding Connections: The connection of windings and terminal markings shall comply with IEEE C57.12.70.
- D. Efficiency: Comply with 10 CFR 431, Subpart K.
- E. Insulation: Transformer kVA rating shall be as follows: The average winding temperature rise above a 30 deg C ambient temperature shall not exceed 65 deg C and 80 deg C hottest-spot temperature rise at rated kVA when tested according to IEEE C57.12.90, using combination of connections and taps that give the highest average winding temperature rise.
- F. Tap Changer: External handle, for de-energized operation. Provide four 2-1/2 taps two above and two below rated voltage.
- G. Tank: welded, with bolt-on cover.
- H. Enclosure Integrity: Comply with IEEE C57.12.28 for pad-mounted enclosures that contain energized electrical equipment in excess of 600 V that may be exposed to the public.
- I. Mounting: An integral skid mounting frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.
 - 1. Fuse Assembly: Bayonet-type, liquid-immersed, expulsion fuses in series with liquid-immersed, partial-range, current-limiting fuses. Bayonet fuse shall sense both high currents and high oil temperature to provide thermal protection to the transformer.
- J. Insulating Liquids:
 - 1. Less-Flammable Liquids:
 - a. Biodegradable and Nontoxic Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92.
- K. Sound level shall comply with NEMA TR 1 requirements.
- L. Corrosion Protection:
 - 1. Transformer coating system shall be factory applied, complying with requirements of IEEE C57.12.28, in manufacturer's standard color.

2.3 THREE-PHASE TRANSFORMERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>ABB (Power Grids Division)</u>.
 - 2. Cooper Industries, Inc.
 - 3. <u>Eaton</u>.

B. Description:

- 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. Comply with IEEE C57.12.26.

C. Compartment Construction:

1. Double-Compartment Construction: Individual compartments for high- and low-voltage sections, formed by steel isolating barriers that extend full height and depth of compartments, with hinged, lift-off doors and three-point latching, with a stop in the open position and provision for padlocking.

D. High-Voltage Section: Dead-front design.

- 1. To connect primary cable, use separable insulated connectors; coordinated with and complying with requirements of Section 260513 "Medium-Voltage Cables." Bushings shall be one-piece units, with ampere and BIL ratings the same as connectors.
- 2. Bushing inserts and feed-through inserts:
 - a. Conform to the requirements of IEEE 386.
 - b. Rated at 200 A, with voltage class matching connectors. Provide a parking stand near each bushing well
 - c. Provide insulated protective caps for insulating and sealing out moisture from unused bushing inserts.
- 3. Bushing wells configured for loop-feed application.
- 4. Dead-front surge arresters.
- 5. Tap-changer operator.
- 6. Ground pad.

E. Low-Voltage Section:

 Bushings with spade terminals drilled for terminating the number of conductors indicated on the Drawings, and the lugs that comply with requirements of Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Capacities and Characteristics:

- 1. Power Rating (kVA): 1500
- 2. Voltage Ratings: 12470 V 480Y/277 V.
- 3. Taps: Comply with IEEE C57.12.26 requirements.
- 4. Transformer BIL (kV): 95 KV BIL at 12470 volt, 30 KV BIL at 480/277 volt.
- 5. Neutral with a fully insulated bushing in secondary compartment.
- 6. Minimum Tested Impedance (Percent at 85 deg C): 5.75.
- 7. Comply with UL listing requirements for combination classification and listing for transformer and less-flammable insulating liquid.

G. Transformer Accessories:

- 1. Drain and filter connection.
- 2. Filling and top filter press connections.
- 3. Pressure-vacuum gauge.
- 4. Dial-type analog thermometer.
- 5. Stainless-steel ground connection pads with threaded grounding lug.

6. Machine-engraved nameplate, made of anodized aluminum or stainless steel.

2.4 WARNING LABELS AND SIGNS

- A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."
 - 1. High-Voltage Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s). Sign legend shall be "DANGER HIGH VOLTAGE" printed in two lines of nominal 2-inch- ((50-mm)-)high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.
 - 2. Arc Flash Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s), warning of potential electrical arc flash hazards and appropriate personal protective equipment required.

2.5 SOURCE QUALITY CONTROL

- A. Provide manufacturer's certificate that the transformer design tests comply with IEEE C57.12.90.
 - 1. Perform the following factory-certified routine tests on each transformer for this Project:
 - a. Resistance.
 - b. Turns ratio, polarity, and phase relation.
 - c. Transformer no-load losses and excitation current at 100 percent of ratings.
 - d. Transformer impedance voltage and load loss.
 - e. Operation of all devices.
 - f. Lightning impulse.
 - g. Low frequency.
 - h. Leak.
 - i. Transformer no-load losses and excitation current at 110 percent of ratings.
 - j. Insulation power factor.
 - Applied potential, except that this test is not required for single-phase transformers or for three-phase Y-Y-connected transformers.
 - l. Induced potential.
 - m. Resistance measurements of all windings on rated voltage connection and at tap extreme connections.
 - n. Ratios on rated voltage connection and at tap extreme connections.
 - o. Polarity and phase relation on rated voltage connection.
 - p. No-load loss at rated voltage on rated voltage connection.
 - q. Exciting current at rated voltage on rated voltage connection.
 - r. Impedance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pad-mounted, liquid-filled, medium-voltage transformers upon delivery.
 - 1. Upon delivery of transformers and prior to unloading, inspect equipment for any damage that may have occurred during shipment or storage.

- 2. Verify that tie rods and chains are undamaged and tight, and that all blocking and bracing is tight. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
- 3. Verify that there is no indication of external damage and no dents or scratches in doors and sill, tank walls, radiators and fins, or termination provisions.
- 4. Verify that there is no evidence of insulating-liquid leakage on transformer surfaces, at weld seams, on high- or low-voltage bushing parts, and at transformer base.
- 5. Verify that there is positive pressure or vacuum on tank. Check pressure gauge; it is required to read other than zero.
- 6. Compare transformers and accessories received with bill of materials to verify that shipment is complete. Verify that transformers and accessories conform with manufacturer's quotation and shop drawings. If shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
- 7. Verify presence of polychlorinated biphenyl content labeling.
- 8. Unload transformers carefully, observing all packing label warnings and handling instructions.
- 9. Open termination compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

- 1. Handle transformers carefully, in accordance with manufacturer recommendations, to avoid damage to enclosure, termination compartments, base, frame, tank, and internal components. Do not subject transformers to impact, jolting, jarring, or rough handling.
- 2. Protect transformer termination compartments against entrance of dust, rain, and snow.
- 3. Transport transformers upright, to avoid internal stresses on core and coil mounting assembly and to prevent trapping air in windings. Do not tilt or tip transformers.
- 4. Verify that transformer weights are within rated capacity of handling equipment.
- 5. Use only manufacturer-recommended points for lifting, jacking, and pulling. Use all lifting lugs when lifting transformers.
- 6. Use jacks only at corners of tank base plate.
- 7. Use nylon straps of same length to balance and distribute weight when handling transformers with a crane.
- 8. Use spreaders or a lifting beam to obtain a vertical lift and to protect transformer from straps bearing against enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
- 9. Exercise care not to damage tank base structure when handling transformer using skids or rollers. Use skids to distribute stresses over tank base when using rollers under large transformers.

C. Storage:

- 1. Store transformers in accordance with manufacturer's recommendations.
- 2. Transformers may be stored outdoors. If possible, store transformers at final installation locations on concrete pads. If dry concrete surfaces are unavailable, use pallets of adequate strength to protect transformers from direct contact with ground. Ensure transformer is level.
- 3. Ensure that transformer storage location is clean and protected from severe conditions. Protect transformers from dirt, water, contamination, and physical damage. Do not store transformers in presence of corrosive or explosive gases. Protect transformers from weather when stored for more than three months.
- 4. Store transformers with compartment doors closed.
- 5. Regularly inspect transformers while in storage and maintain documentation of storage conditions, noting any discrepancies or adverse conditions. Verify that an effective pressure seal is maintained using pressure gauges. Visually check for insulating-liquid leaks and rust spots.
- D. Examine areas and space conditions for compliance with requirements for pad-mounted, liquid-filled, medium-voltage transformers and other conditions affecting performance of the Work.

- E. Examine roughing-in of conduits and grounding systems to verify the following:
 - 1. Wiring entries comply with layout requirements.
 - 2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will cross section barriers to reach load or line lugs.
- F. Examine concrete bases for suitable conditions for transformer installation.
- G. Pre-Installation Checks:
 - 1. Verify removal of any shipping bracing after placement.
 - 2. Remove a sample of insulating liquid according to ASTM D 923. Insulating-liquid values shall comply with NETA ATS, Table 100.4. Sample shall be tested for the following:
 - a. Dielectric Breakdown Voltage: ASTM D 877 or ASTM D 1816.
 - b. Acid Neutralization Number: ASTM D 974.
 - c. Specific Gravity: ASTM D 1298.
 - d. Interfacial Tension: ASTM D 971.
 - e. Color: ASTM D 1500.
 - f. Visual Condition: ASTM D 1524.
 - g. Water in Insulating Liquids: Comply with ASTM D 1533.
 - h. Power Factor or Dissipation Factor: ASTM D 924.
- H. Verify that ground connections are in place and that requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at transformer location.
- I. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations.
- B. Transformer shall be installed level and plumb and shall tilt less than 1.5 degrees while energized.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and IEEE C2.

3.3 CONNECTIONS

- A. Ground equipment to existing transformer ground.
 - 1. Make joints in grounding conductors and loops by exothermic weld or compression connector.
 - 2. Terminate all grounding and bonding conductors on a common equipment grounding terminal on transformer enclosure.
 - 3. Complete transformer tank grounding and lightning arrester connections prior to making any other electrical connections.
- B. Connect wiring.
 - 1. Maintain air clearances between energized live parts and between live parts and ground for exposed connections in accordance with manufacturer recommendations.

- 2. Bundle associated phase, neutral, and equipment grounding conductors together within transformer enclosure. Arrange conductors such that there is not excessive strain that could cause loose connections. Allow adequate slack for expansion and contraction of conductors.
- C. Terminate medium-voltage cables in incoming section of transformers according to Section 260513 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

- A. Comply with installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."
- B. Install warning signs as required to comply with 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections[with the assistance of a factory-authorized service representative]:
 - 1. General Field-Testing Requirements:
 - a. Comply with provisions of NFPA 70B Ch. "Testing and Test Methods."
 - b. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
 - c. After installing transformer but before primary is energized, verify that grounding system at the transformer is tested at specified value or less.
 - d. After installing transformer and after electrical circuitry has been energized, test for compliance with requirements.
 - e. Visual and Mechanical Inspection:
 - 1) Verify equipment nameplate data complies with Contract Documents.
 - 2) Inspect bolted electrical connections for high resistance using one of the following two methods:
 - a) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In absence of manufacturer's published data, use NETA ATS, Table 100.12.
 - f. Remove and replace malfunctioning units and retest.
 - g. Prepare test and inspection reports. Record as-left set points of all adjustable devices.
 - 2. Medium-Voltage Surge Arrester Field Tests:
 - a. Visual and Mechanical Inspection:
 - 1) Inspect physical and mechanical condition.
 - 2) Verify arresters are clean.
 - 3) Verify that ground lead on each device is individually attached to a ground bus or ground electrode.

3. Liquid-Filled Transformer Field Tests:

- a. Visual and Mechanical Inspection:
 - 1) Test dew point of tank gases if applicable.
 - 2) Inspect anchorage, alignment, and grounding.
 - 3) Verify bushings are clean.
 - 4) Verify that liquid level in tanks is within manufacturer's published tolerances.
 - 5) Perform specific inspections and mechanical tests recommended by manufacturer.
 - 6) Verify presence of transformer surge arresters and that their ratings are as specified.
 - 7) Verify that as-left tap connections are as specified.

b. Electrical Tests:

- 1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; the value of the index shall not be less than 1.0.
- 2) Measure core insulation resistance at 500-V dc if the core is insulated and the core ground strap is removable. Core insulation-resistance values shall not be less than 1 megohm at 500-V dc.
- Perform a power-factor or dissipation-factor tip-up test on windings greater than 2.5 kV.
- 4) Perform turns-ratio tests at tap positions. Turns-ratio test results shall not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
- 5) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- Remove a sample of insulating liquid according to ASTM D 923, and perform dissolved-gas analysis according to IEEE C57.104 or ASTM D 3612.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 261219

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Disconnecting and overcurrent protective devices.
 - 3. Instrumentation.
 - 4. Control power.
 - 5. Identification.

1.3 RELATED SECTIONS

A. Section 260573.19 "Overcurrent Protective Device Arc-Flash Study" for arc-flash study and arc-flash label requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
 - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Delegated Design Submittal:
 - 1. For arc-flash hazard study.
 - 2. For arc-flash labels.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

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c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

1.7 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
 - 1. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 2.
- E. Comply with NFPA 70.

- F. Comply with UL 891.
- G. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Panel mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- H. Nominal System Voltage: 480Y/277 V.
- I. Main-Bus Continuous: See drawings.
- J. Indoor Enclosures: Steel, NEMA 250, Type 1.
- K. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- L. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
- M. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 - 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
 - 3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 4. Copper feeder circuit-breaker line connections.
 - 5. Tin-plated aluminum feeder circuit-breaker line connections.
 - 6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 7. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
- N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.

- d. Ground-fault pickup level, time delay, and I²t response.
- 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
- B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
 - 1. Fixed circuit-breaker mounting.
 - 2. Two-step, stored-energy closing.
 - 3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Time adjustments for long- and short-time pickup.
 - c. Ground-fault pickup level, time delay, and I²t response.

2.3 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, and the following:
 - 1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices
 - 2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
 - d. Megawatts: Plus or minus 1 percent.
 - e. Megavars: Plus or minus 1 percent.
 - f. Power Factor: Plus or minus 1 percent.
 - g. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
 - h. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
 - i. Contact devices to operate remote impulse-totalizing demand meter.
 - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.4 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- B. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Install filler plates in unused spaces of panel-mounted sections.
- E. Install overcurrent protective devices, surge protection devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Comply with NECA 1.

3.3 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- C. Support and secure conductors within the switchboard according to NFPA 70.
- D. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 **DEFINITIONS**

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.

4. Detail bus configuration, current, and voltage ratings.

- 5. Short-circuit current rating of panelboards and overcurrent protective devices.
- 6. Include evidence of NRTL listing for series rating of installed devices.
- 7. Include evidence of NRTL listing for SPD as installed in panelboard.
- 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 9. Include wiring diagrams for power, signal, and control wiring.
- 10. Key interlock scheme drawing and sequence of operations.
- 11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
 - 3. Copy of Final Panel Schedules.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

- 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 - 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.

- a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
- b. Outdoor Locations: NEMA 250, Type 3R.
- c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
- d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
- 2. Height: 84 inches (2.13 m) maximum.
- 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
- 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
- 7. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.

G. Incoming Mains:

- 1. Location: Convertible between top and bottom.
- 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

- 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
- 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
- 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

- 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - 1. Percentage of Future Space Capacity: Five percent.
- L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected shortcircuit rating.
 - 1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Eaton</u>
 - 2. <u>Siemens Industry, Inc., Energy Management Division.</u>
 - 3. Square D; Schneider Electric USA.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs Only.

- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. <u>Siemens Industry, Inc., Energy Management Division</u>.
 - 3. Square D; Schneider Electric USA.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. <u>Siemens Industry, Inc., Energy Management Division.</u>
 - 3. Square D; Schneider Electric USA.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 5. Subfeed Circuit Breakers: Vertically mounted.
 - 6. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.

- c. UL listed for reverse connection without restrictive line or load ratings.
- d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
- f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- g. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
- h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch (32 mm) in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- O. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

 Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 - 1. Measure loads during period of normal facility operations.
 - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed controllers.
 - c. Enclosed switches.
 - 2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.

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- 2. Current-limitation curves for fuses with current-limiting characteristics.
- 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
- 4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>Bussmann; Eaton, Electrical Sector</u>.
 - 2. <u>Littelfuse, Inc.</u>
 - 3. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class RK1, time delay.
 - 2. Large Motor Branch (601-4000 A): Class L, time delay.
 - 3. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings (Mechanical room 107 or 108) or as indicated in the field by Owner.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

FUSES 262813 - 3

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Enclosures.

1.3 **DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

- 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>ABB (Electrification Products Division)</u>.
 - 2. Eaton.
 - 3. Schneider Electric USA (Square D).
 - 4. <u>Siemens Industry, Inc., Energy Management Division.</u>
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.
 - 4. 1200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

- 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
- 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
- 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
- 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating 208-V ac.
- 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
- 6. Lugs: Compression type, suitable for number, size, and conductor material.
- 7. Service-Rated Switches: Labeled for use as service equipment.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12) a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Steam Vaults: NEMA 250, Type 4X, stainless steel.
 - 4. Chilled Water Vaults: NEMA 250, Type 4.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 262913.03 – MANUAL AND MAGNETIC CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.

1.3 **DEFINITIONS**

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.

- f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
- 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- C. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.7 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.11 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Configuration: Nonreversing.
 - 2. Surface mounting.
 - 3. Green pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Configuration: Nonreversing.
 - 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 3. Surface mounting.
 - 4. Red pilot light.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Configuration: Nonreversing.
 - 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
 - 3. Surface mounting.
 - 4. Red pilot light.

- 5. Auxiliary contact.
- E. Magnetic Controllers: Full voltage, across the line, electrically held.
 - 1. Configuration: Nonreversing.
 - 2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 4. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
 - 5. Melting Alloy Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 20 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - 6. N.C. N.O., isolated overload alarm contact.
 - 7. External overload reset push button.
- F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
 - 1. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - 2. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.

- a. Push Buttons:momentary as indicated.
- b. Pilot Lights: LED types; colors as indicated; push to test.
- c. Selector Switches: Rotary type.
- 2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
- 3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. Two sets of N.C and N.O auxiliary contacts.
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- H. Cover gaskets for Type 1 enclosures.
- I. Terminals for connecting power factor correction capacitors to the load side of overload relays.
- J. Spare control wiring terminal blocks, quantity as indicated; unwired.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

- C. Install fuses in each fusible-switch enclosed controller.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- G. Install power factor correction capacitors. Connect to the side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:

- 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
- 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
- 3. Test continuity of each circuit.
- 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
- 5. Test each motor for proper phase rotation.
- 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 80 percent.
- E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- F. Set field-adjustable circuit-breaker trip ranges

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913.03

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENT

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: LED Light Fixtures.

1.3 **DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom luminaires.

- 1. Include plans, elevations, sections, and mounting and attachment details.
- 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.
- B. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 - 1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
 - 1. Manufacturer's standard grade.
 - 2. Manufacturer's standard type, ASTM A240/240M.

- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Recessed lighting fixtures installed in a grid type ceiling are to be supported independently from the grid. Support the fixture from the structure above with 12 gauge wire one on each corner of the fixture.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.

D. Supports:

- 1. Sized and rated for luminaire weight.
- 2. Able to maintain luminaire position after cleaning and relamping.
- 3. Provide support for luminaire without causing deflection of ceiling or wall.
- 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

- 1. Secured to outlet box.
- Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
- 3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

- 1. Attached to structural members in walls.
- 2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:

- a. Two 5/32-inch- (4-mm-) diameter aircraft cable supports.
- b. Pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports.
- 2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
- 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
- 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
- 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

- 1. Secure to any required outlet box.
- 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Non-integral LED Drivers and Power Supplies:

- 1. LED drivers and power supplies which are not integral to the lighting fixture and which require separate mounting are to be installed in a concealed, but accessible location.
- 2. Where such mounting exceeds the limitations on the low voltage cabling connection to the fixture, provide additional hardware, wiring, and connections as required to accommodate the longer distance to the fixture.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide onsite assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265619 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.4 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.5 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. CRI of minimum 80. CCT.
- E. L70 lamp life of 50,000 hours.
- F. Internal driver.
- G. In-line Fusing: Separate in-line fuse for each luminaire.
- H. Lamp Rating: Lamp marked for outdoor use.
- I. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- F. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.

- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.3 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.

- 2. Able to maintain luminaire position after cleaning and relamping.
- 3. Support luminaires without causing deflection of finished surface.
- 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 265619

DIVISION 27 - COMMUNICATIONS

SECTION 270100 - BASIC COMMUNICATION REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Include in bid all labor, contractor provided materials, tools, plant, transportation, storage costs, excavation, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational systems shown and described
- B. References to codes and Standards called for in the Contract Documents mean the latest edition, amendment and revisions to the codes and standards in effect on the date of these Contract Documents.
 - 1. Minimum composition requirements and/or installation methods for the following materials and work are included in this section:
 - a) Miscellaneous Supports
 - b) Access Doors and Panels
 - c) Fire Stopping
 - d) Flashing and Sealing
 - e) Cutting and Patching
 - f) Waterprooofing
- C. Contract shall include, but not be limited to:
 - 1. Basic Communications Requirements (Section 27 0100)
 - 2. Multifunctional Communications Rooms (MCR) (Section 27 1100)
 - 3. Interior Communication Pathways (Section 27 1200)
 - 4. Backbone (Intra and Inter-Building) Cabling (Section 27 1400)
 - 5. Horizontal Cabling (Section 27 1500)
 - 6. Testing, Identification, and Administration (Section 27 1600)
 - 7. Support and Warranty (Section 27 1700)
 - 8. KCTCS Approved Materials List (Section 27 2000)
 - 9. Other Voice, Data and Video Communication System Infrastructure

1.2 RELATED SECTION AND DOCUMENTS

A. All drawings and general provisions of Contract, including all General and Supplementary Conditions, Division 1 Specification Sections, and Instructions to Bidders apply to this section and all other sections of Division 25.

1.3 REGULATIONS AND CODE COMPLIANCE

- A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of federal, state and local governmental agencies.
- B. The following is a list of codes and standards that will apply to this project:
 - 1. Kentucky Uniform Fire Prevention and Building Code.

- 2. Kentucky Department of Labor Rules and Regulations.
- 3. Kentucky Department of Health.
- 4. Federal Occupational Safety and Health Administration OSHA.
- 5. National Life Safety Code, NFPA 101.
- 6. National Electrical Code, NFPA 70 1999 edition.
- 7. Underwriters Laboratory (UL).
- 8. Factory Mutual and/or Owner's Insurance Carrier.
- 9. ANSI/TIA/EIA Building Telecommunications Standards.
- 10. BICSI Telecommunications Distribution Methods Manual.
- 11. IEEE Standards.
- 12. Federal Communications Commission.
- 13. NEMA National Electrical Manufacturers' Association
- 14. Customer Environmental Health and Safety Standards.
- 15. Occupational Safety and Health Administration
- 16. ADA, Americans with Disabilities Act
- 17. KCTCS Design Guidelines and Specifications

2.2 RELATED SECTION AND DOCUMENTS

A. All drawings and general provisions of Contract, including all General and Supplementary Conditions, Division 1 Specification Sections, and Instructions to Bidders apply to this section and all other sections of the Kentucky Community and Technical College System (KCTCS) Design Guidelines and Specifications.

2.3 REGULATIONS AND CODE COMPLIANCE

- A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of federal, state and local governmental agencies.
- B. It will be the contractor's responsibility for knowing and following all local, state, and national codes, standards and regulations that will apply to this project.
- C. This document does not replace any national or local standards, regulations or codes, but enhances them. If the standards and practices of KCTCS exceed national or local standards, regulations or codes, KCTCS's practices shall take precedent.

2.4 INTENT OF DRAWINGS

- A. The drawings are diagrammatic, unless detailed dimensioned drawings are included. Drawings show approximate locations of equipment, and fixtures. Exact locations are subject to the approval of the Owner's Representative.
- B. Anything mentioned in the Specifications and not shown in the Drawings, or shown in the Drawings and not mentioned in the Specifications, shall be of like effect as if shown and mentioned in both. In case of differences between the Drawings and the Specifications, the stricter provision as determined by the Owner's Representative shall govern.
- C. Omissions from the Drawings or Specifications, or the incorrect description of details of Work which are evidently necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or incorrect described detailed of the Work.

2.5 REVIEW OF THE CONTRACT DOCUMENTS

- A. The contractor shall carefully study and compare the Contract Documents and shall at once report to the consultant and project manager any error, inconsistency or omission he may discover. If contractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the contract documents without such notice to the Consultant or Owner, the contractor shall assume appropriate responsibility for such performance and shall bear and appropriate amount of the attributable cost for correction.
- B. The contractor must verify all dimensions locating the work and its relation to existing work, all existing conditions and their relation to the work and all man made obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the Contract Documents.

2.6 EXAMINATION OF THE PREMISES

- A. Contractor shall visit Site to familiarize himself with the local conditions under which the work is to be performed and correlate his observations with the requirements of the Contract Documents. No allowance will be made for claims for concealed conditions which Contractor, in exercise or reasonable diligence in it observations of the Site and review of the local conditions under which the work is to be performed, learned or should have learned of, unless otherwise specifically agreed by Owner and Consultant in writing.
- B. Before ordering any materials or doing any work, the contractor shall verify all measurements and be responsible for correctness of same. No extra charge or compensation will be allowed for duplicate work or material required because of an unverified difference between an actual dimension and the measurement indicated in the drawings. Any discrepancies found shall be submitted in writing to the Project Manager and Consultant for consideration before proceeding with the work.

2.7 PROJECT MEETINGS

A. Job Start Meeting

1. Before starting the work the Contractor shall attend a job start meeting at which his Crew Leader and Project Manager and any other the parties as the Project Coordinator may designate shall be present. This meeting is intended to familiarize contractor personnel with the other parties to this and other projects being undertaken at the same time, to review all requests for facilities by the Contractor and subcontractors, to review the Owner's representatives requirements and concerns, to permit the designers to review and interpret the project documents and for the Contractor to discuss the anticipated project schedule established in this Agreement.

B. Facility Review

1. Contractor shall conduct a walk through with the Owner's Representative of all work areas, describing specific work methods and proposed schedules, before commencing work, enabling the Project Coordinator to identify areas of concern, desired installation timetables and review important procedural and safety precautions.

C. Project Meetings

1. Through out the duration of the project the contractor shall attend the project meetings to review the status of current and planned activities, to review the schedule and to conduct other business associated with the project.

2.8 COORDINATION WITH OWNER

A. Advise owner as early as possible of any product delays and minimum quantity requirements that may affect project timeline.

2.9 SUPERINTENDENT

A. The Contractor shall give his personal superintendent to the Work or have a competent qualified Crew Leader, satisfactory to the Project Manager and to Owner's Representative, on the Work at

all times during the contractor's work progress, with authority to act for him. All communications given to the Crew Leader will be deemed to have been given to the Contractor. The Contractor without the approval of the Project Manager will not remove an approved Crew Leader from the Work, unless that Crew Leader leaves the employ of the Contractor.

2.10 WORK RESTRICTIONS AND ACCESS TO THE SITE

A. Hours of work and access to the site are to be coordinated with the General Contractor.

2.11 SAFETY PRECAUTIONS AND PROGRAMS

A. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work.

2.12 WORKMANSHIP, SUBSITUTIONS AND WARRANTY

- A. All cable shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and acceptance of KCTCS Network Operations and KCTCS Facility Management.
- B. All work shall adhere to the latest versions of the Reference Documentation:

2.13 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS

- A. All contractor provided materials shall meet the following minimum requirements:
 - 1. All equipment and material for which there is a listing service shall bear a UL label.
 - 2. Materials used in this Contract shall meet Kentucky Fire, Gas and Toxicity Requirements and be listed in the Directory of approved products filed under the Kentucky Fire Prevention and Building Code for use in Kentucky.
 - 3. The Contractor shall furnish and file with the proper Authorities all drawings required by them in connection with this work. The Contractor, if required, shall obtain all official permits, licenses and inspections and shall pay all legal and proper fees and charges.
 - 4. The Contractor shall at inception of the work provide the Project Coordinator with copies of all required building and trade permits, if said are required.
 - 5. The Contractor shall be responsible for arranging all inspections and for securing all required signatures. Upon completion of the work, properly completed permits shall be returned to the Project Coordinator, if any are required.
 - 6. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory of Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

2.14 WORKMANSHIP, CONTRACTOR REQUIREMENTS

- A. Materials supplied by the contractor and workmanship shall meet or exceed industry standards and be fully guaranteed for one full year from final acceptance. Cable integrity and associated termination's shall be thoroughly inspected, fully tested and guaranteed as free from defects, transpositions, opens-shorts, tight kinks, damaged jacket insulation, etc.
- B. Communication Contractor Requirements
 - 1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.
 - 2. Contractor to have a BICSI Registered Communications Distribution Designer (RCDD) in good standing on staff, submit proof with bid.
 - 3. The contractor's Site Foreman/Crew manager shall be a BICSI Technician in good standing and a minimum of 50% of labor force shall be BICSI certified installers in good standing, submit proof of certification with bid.

- 4. Contractor shall be responsible for testing, certification administration and identification of all backbone and horizontal cabling and devices as stated in Section 25160 Testing, Identification and Administration.
- 5. All vendors, contractors, supervisors and laborers must be certified to meet all stated manufacturer's warranty as stated in Section 25170 Support and Warranty.
- 6. Contractor shall be responsible for resolving any manufacturer warranty issues with the distributor and the manufacturer for all provided materials
- 7. Contractor shall be responsible for and make good, without expense to the Owner, any and all defects arising during this warranty period for installed components that are due to imperfect provided materials, appliances, improper installation or poor workmanship.

2.15 SPECIAL TOOLS

A. If any part of equipment installation requires special tools or materials (other than those provided by KCTCS) for install, assembly, adjustment, labeling, testing or maintenance thereof, it shall be furnished by the Contractor.

2.16 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered without bending or distortion of shape, such as rapid lowering and braking of load.

2.17 FIRESTOPPING

- A. Fire stopping for Openings Through Fire and Smoke Rated Walls and Floor Assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire-Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire-Stops" designated ASTM E814-13A.
- B. Inside of all conduits, the fire-stop system shall consist of a dielectric, water resistant, non hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.
- C. Add fire-stop pillows specs for sealing existing cable tray penetrations through firewall
- D. All conduit and sleeve openings used by this Contractor shall be waterproofed or fireproofed in compliance with Kentucky Building and Fire Codes. Strict adherence to National and State Fire Codes, particularly fire-stopping will be required.
- E. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire-stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.
- F. All building conduits and sleeves installed and/or used under this contract shall be fire-stopped, or re-fire-stopped, upon cable placement through such passageways.
- G. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

2.18 ROUGH-IN

A. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways. Identify all required core locations.

- B. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, etc. Verify final locations for installation with field measurements and with the equipment being connected. Verify exact location and elevations at work site prior to any rough in work. If field conditions, details, changes in equipment or shop drawing information require a significant change to the original documents, contact the owner's representative for approval before proceeding.
- C. All equipment locations shall be coordinated with other trades, other renovation projects, and existing conditions to eliminate interference with required clearances for equipment maintenance and inspections.
 - Coordinate work with other trades, other renovation projects, and existing conditions to determine exact routing of all cable tray, hangers, conduit, etc., before fabrication and installation. Coordinate with Technology Drawings. Verify with Owner's Representative exact location and mounting height of all equipment in finished areas, such as Cable Tray, Equipment racks, Patch panels, Consolidation Points, Recessed Floor Box Outlets. Coax Locations and other telecommunications WAO and devices.
 - 2. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Owner's Representative and approval received before such alterations are made.
- D. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation.

2.19 CONCEALMENT

A. Use existing conduit and surface raceway where possible and practicable. Conceal all contract work above ceilings and in walls, below recessed floor, in slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

2.20 CHASES

A. General:

- 1. Certain chases, closets, recesses, openings, shafts, and wall pockets will be provided as part of this project. The Division 25 contractor shall provide all other openings required for their contract work.
- 2. Field verify for correct size and location for all openings, recesses and chases.
- 3. Assume responsibility for correct and final location and size of such openings.
- 4. Seal voids in fire rated assemblies with a fire-stopping seal system to maintain the fire resistance of the assembly.
- 5. In wall openings, drill or cut holes to suit. Provide 18 gauge galvanized sleeves at shafts and fire rated assemblies. Provide fire-stopping seal between sleeves and wall in drywall construction. Provide fire-stopping similar to that for floor openings.

2.21 WATERPROOFING

- A. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits.
- B. Spare conduits shall be plugged with expandable plugs.
- C. All service entrance conduits through building shall be sealed or resealed upon cable placement.
- D. Conduits with cables in them shall be permanently sealed by firmly packing the void around the cable with oakum and capping with a hydraulic cement or waterproof duct seal.

2.22 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate ordering and installation of all contractor installed materials with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.
- B. Where mounting heights are not detailed or dimensioned, consult with Owner's Representative prior to installing systems, materials or equipment.
- C. Set all equipment to accurate line and grade, level all equipment and align all equipment components.
- D. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.
- E. No equipment or installed materials shall be hidden or covered up prior to inspection by the owner's representative. All work that is determined to be unsatisfactory shall be corrected immediately.
- F. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.
- G. Contractor shall replace all ceiling tiles damaged by work performed as part of Division 25 contract.

2.23 FIRE-STOPPING

- A. Fire-stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:
 - 1. Provide materials and products listed. The system shall meet the requirements of "Fire Tests of Through-Penetration Fire-Stops" designated ASTM E814-13A. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.
 - 2. Provide fire-stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.
 - 3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.
 - 4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:
 - a) Floors 1 hours
 - b) Corridor walls 1 hours
 - c) Offices 3/4 hour
 - d) Smoke partitions 3/4 1 hour

5. Provide proper fire-stop assemblies for existing cable tray or other penetrations through firewalls.

2.24 TRAINING

- A. Contractor shall provide 40 hours of training and orientation of customer personnel to new cable plant.
- B. Training shall include, but will not be limited to:
 - 1. Physical review of installed cable plant.
 - 2. Review of cable plant documentation and test results
 - 3. Explanation of all "As Builts" and Documentation.

END OF SECTION 270100

SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - Wire-basket cable trays.

1.3 SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: 12" x 4" deep unless otherwise noted on the drawings.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
 - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.2 WIRE-BASKET CABLE TRAYS

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>B-line, an Eaton business.</u>
 - 2. <u>Hubbell Incorporated; Wiring Device-Kellems</u>.
 - 3. MonoSystems, Inc.

B. Description:

- 1. Configuration: Wires are formed into a standard 2-by-4-inch (50-by-100-mm) wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
- 2. Materials: High-strength-steel longitudinal wires with no bends.
- 3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
- 4. Sizes:
 - a. Straight sections shall be furnished in standard 118-inch (3000-mm) lengths.
 - b. Wire-Basket Depth: 4-inch (100-mm) usable loading depth by 12 inches (300 mm) wide.
- 5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
- 6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
- 7. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.3 MATERIALS AND FINISHES

A. Steel:

- 1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.
- 2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
- 3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
- 4. Finish: Electrogalvanized before fabrication.
 - a. Standard: Comply with ASTM B 633.
 - b. Hardware: Galvanized, ASTM B 633.

2.4 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA FG 1.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg). Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548.16 "Seismic Controls for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.
- L. Support wire-basket cable trays with trapeze hangers.
- M. Support trapeze hangers for wire-basket trays with 1/4-inch- (6-mm-) diameter rods.
- N. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- O. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.
- P. Make changes in direction and elevation using manufacturer's recommended fittings.
- Q. Make cable tray connections using manufacturer's recommended fittings.
- R. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

- S. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- T. Install cable trays with enough workspace to permit access for installing cables.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70.
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).
- E. Tie MI cables down every 36 inches (900 mm) where required to provide a 2-hour fire rating and every 72 inches (1800 mm) elsewhere.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 PROTECTION

A. Protect installed cable trays and cables.

- 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
- 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
- 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 270536

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Grounding.

1.3 **DEFINITIONS**

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

- Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
- 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.2 EQUIPMENT FRAMES

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 2. B-line, an Eaton business.
 - 3. Ortronics, Inc.
- B. General Frame Requirements:
 - 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
 - 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, steel or aluminum construction.
 - 1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug.
 - 2. Baked-polyester powder coat finish.
- D. Cable Management for Equipment Frames:
 - 1. Metal, with integral wire retaining fingers.
 - 2. Baked-polyester powder coat finish.
 - 3. Vertical cable management panels shall have front and rear channels, with covers.
 - 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.3 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Rack mounting.
 - 3. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - 4. LED indicator lights for power and protection status.

- 5. LED indicator lights for reverse polarity and open outlet ground.
- 6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
- 7. Close-coupled, direct plug-in line cord.
- 8. Rocker-type on-off switch, illuminated when in on position.
- 9. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
- 10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.4 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with J-STD-607-A.

2.5 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment, IT personnel, and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

- 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, Engineer, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
- 2. Record agreements reached in meetings and distribute them to other participants.
- 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
- 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- F. Install fire treated plywood on all walls of each telecommunications room from 6" AFF to 8'-6" AFF and with fire rating stamp facing the room side of plywood.

3.3 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
- B. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 27 12 00 - INTERIOR COMMUNICATION PATHWAYS

PART 1 GENERAL

1.1 Summary

A. SCOPE

- 1. This section includes minimum requirements for the following:
 - a) Interior Horizontal Cabling Communication Pathways
 - b) Interior Backbone Cabling Communication Pathways
- 2. Minimum composition requirements and installation methods for the following pathways:
 - a) Conduit
 - b) Innerduct
 - c) Sleeves
 - d) Cable tray
 - e) Cable hangers
 - f) Wireways and wire troughs
 - g) Floor Boxes and Poke Throughs
 - h) Outlet Boxes
 - i) Telecommunications Grounding Bus Bar
 - j) Related Sections include the following:
 - 1) 25140 Backbone Cabling Requirements
 - 2) 25150 Horizontal Cabling Requirements

1.2 QUALITY ASSURANCE

- A. The contractor shall engage the services of a qualified installer for all pathways and associated equipment.
- B. All work shall be done in a neat and workmanlike manner.
- C. All methods of construction and installation shall follow all applicable national, state, and local codes, standards, regulations and KCTCS specifications.
- D. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where "accepted equal" is stated, equipment shall be equivalent in every way to that of the equipment specified.
- E. Materials and work specified herein shall comply with all applicable requirements of:
 - 1. National Electric Code (NFPA 70)

- 2. American National Standards Institute (ANSI) standards
- 3. Telecommunication Industry Association (TIA) standards.
 - a) ANSI/TIA/EIA 568-D.0 Commercial Building Telecommunications Cabling Standard
 - b) ANSI/TIA-568-D.1 Commercial Building Telecommunications Standard
 - c) ANSI/TIA-568-D.1 Commercial Building Telecommunications Standard
 - d) ANSI/TIA/EIA 569-D Commercial Building Standard for Telecommunications Pathway and Spaces
 - e) EIA/TIA-606-B Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - f) EIA/TIA-607-C Commercial Building Grounding and Bonding requirements for Telecommunications
- 4. BICSI guidelines
 - a) BICSI Telecommunications Distribution Methods Manual
 - b) BICSI Customer Owned Outside Plant Design Manual
 - c) BICSI Telecommunications Cabling Installation Manual
- OSHA Guidelines
- 6. UL Standards
- 7. KCTCS Design Guidelines and Specifications

1.3 SUBMITTALS

- A. Provide product data for the following:
 - 1. Conduit
 - 2. Innerduct
 - 3. Sleeves
 - 4. Cable tray
 - 5. Non-continuous cable support (Category 5e, 6 and optical fiber cable hangers).
 - 6. Wireways and wire troughs
 - 7. Floor Boxes and Poke Throughs
 - 8. Surface Raceways Metallic
 - 9. Outlet Boxes

PART 2 PRODUCTS

2.1 CONDUIT

A. Rigid Galvanized Steel Conduit

1. Shall be hot-dipped galvanized steel, including threads.

B. Electrical Metallic Tubing

1. Electrical Metallic Tubing shall be electro-galvanized steel.

C. Rigid Non-Metallic PVC Conduit

- 1. Extra-Heavy wall conduit: Schedule 80, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and normal above ground use.
- 2. Heavy wall conduit: Schedule 40, constructed of polyvinyl chloride, rated for use with 90 degree C conductors, and UL listed for direct burial and concrete encasement.

D. Fittings

- 1. Rigid galvanized steel fittings shall be fully threaded and shall be of the same material as the respective raceway system.
- 2. Fittings for electrical metallic tubing shall be non-set screw fittings for conduits up to 2" and double screw indenter fittings for conduits 2" and larger.
- Fittings for rigid non-metallic conduit shall be solvent cemented in accordance with the manufacturer's instructions.
- 4. Connectors shall have insulated throat up to and including 1" size. For sizes 1-1/4" and larger, provide plastic insulating bushing.
- 5. Die-cast or pressure cast fittings are not permitted.
- 6. Provide conduit bodies types, shapes and sizes as required to suit application and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

E. Expansion Fittings

- 1. Provide expansion fittings with external grounding straps at building expansion joints.
- 2. Galvanized steel expansion joints for RGS or EMT conduit, PVC for PVC conduit.
- 3. Minimum 4" movement in either direction.
- 4. Weatherproof for outdoor applications.
- 5. At expansion joints in concrete pours, provide Deflection/Expansion fittings capable of movement of 3/4" in all directions from the normal.

F. Waterproofing Seals

1. Provide watertight expanding link-type seals for installation between the conduit and the sleeve or core drilled hole.

G. Pull and Junction Boxes

1. Shall be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed.

- 2. Provide covers. (Hinged where applicable)
- 3. Boxes installed in damp or wet locations shall be of raintight construction with gasketed cover and threaded conduit hubs.
- 4. In no case shall boxes be sized smaller than as indicated in Article 370 of the National Electrical Code for conduit and conductor sizes installed.
- 5. Shall have provisions for grounding.
- 6. Shall be NEMA approved for the environmental condition of the location where they will be installed.
- 7. Shall provide knock outs on all 4 sides.
- 8. Shall be UL 50 listed.

2.2 INNERDUCT

- A. Shall be constructed of riser or plenum rated materials as required.
- B. Shall be 1", 1-1/4" 1-1/2" or 2" in diameter as called for on the drawings.
- C. Shall be orange and white in color.
- D. Riser Rated innerduct shall be UL listed to 1666 standard.
- E. Plenum Rated innerduct shall be UL listed to 910 standard.
- F. Design Make:
 - 1. See KCTCS Approved Materials List
- G. Acceptable Manufacturers:
 - 1. Submit

2.3 SLEEVES

- A. Shall be 4" EMT unless otherwise called for on drawings.
- B. Shall have nylon bushings installed on either end.
- C. Shall be bonded back to Telecommunications Ground Bar located in the MCR that is serving the area in which the sleeves are installed.

2.4 CABLE MANAGEMENT SYSTEM (CABLE TRAY)

2.5 CABLE TRAY

- A. Provide a minimum of 4 inches deep and 12 inches wide cable tray
- B. Include connecting and support hardware to suit installation.
- C. Must be properly supported (every 6-10 feet) to handle cable load.
- D. Trays shall have an electro zinc finish unless other required by installation.
- E. Shall have a welded wire design. (basket weave)

- F. Design Make:
 - 1. See KCTCS Approved Materials List
- G. Acceptable Manufacturers:
 - 1. Submit

2.6 CABLE HANGERS

- A. Support hardware and fasteners shall be protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products used in outdoor applications shall be hot dipped galvanized.
- B. Provide proper containment and support for Category 6 cables and sized for proper cable capacity per project requirements.
- C. Shall have fittings available for mounting to all surfaces.
- D. Design Make:
 - 1. See KCTCS Approved Materials List
- E. Acceptable Manufacturers:
 - 1. Submit

2.7 CONTINUOUS CABLE SUPPORT SYSTEM

- A. Steel support brackets shall be galvanized steel and capable of supporting a minimum of 200 pounds with a safety factor of 3.
 - 1. Steel support brackets shall have a galvanized steel retaining strap, which is removable.
 - 2. Steel support brackets shall accept 3/8" threaded rod for attachment to building structure or sub structure.
- B. Cable support shall be of a flexible mesh design that is extruded from polyethylene and available in 25' lengths. As a special order, one-piece lengths of up to 500' shall be available.
 - 1. Flexible mesh sections shall be connected together by non-metallic splice clips.
 - 2. Cable support shall provide 32 square inches of cable containment area.
- C. Provide proper containment and support for Category 6 cables and sized for proper cable capacity per project requirements.
- D. Shall have fittings available for mounting to all surfaces.
- E. Design Make:
 - 1. See KCTCS Approved Materials List
- F. Acceptable Manufacturers:
 - 1. Submit

2.8 WIREWAYS AND WIRE TROUGHS

- A. Wireway shall be steel, enclosed type. Provide hinged, JIC sectional NEMA dust resistant, oil tight type where subjected to moisture, in Pump Rooms, Mechanical, Electric and Fan Rooms, exterior walls, Maintenance Shops, and similar locations.
- B. Size to meet NEC fill requirements or larger as noted on Contract Documents. Provide knockouts along runs. Provide all elbows, tees, pull-boxes, fittings, hangers, reducers, supports, etc., to meet installation requirements.
- C. Cover: Hinged Screw cover with full gasketing
- D. Connector: [Slip-in] [Flanged].
- E. Fittings: Lay-in type with removable top.
- F. Finish: Electro-coated ASA-49 Gray Epoxy Paint over Phosphate Primer.

2.9 OUTLET BOXES

- A. Outlet Boxes and Covers
 - 1. Shall be galvanized steel, not less than 2 ¾" deep X 4 11/16" square or octagonal, with knockouts.
 - 2. Outlet boxes exposed to moisture, exterior, wet or damp locations shall be cadmium cast alloy complete with threaded hubs and gasketed screw fastened covers.
 - 3. Boxes shall be approved for the environmental condition of the location where they will be installed.
 - 4. Install with mud ring where possible
- B. Design Make:
 - Crouse Hinds
- C. Acceptable manufacturers:
 - Steel City
- D. Low Voltage Mounting Brackets
 - 1. Shall mount to any wall thickness from $\frac{1}{4}$ " 1".
 - 2. Shall be constructed of a non-metallic material.
- E. Design Make:
 - 1. Arlington
- F. Acceptable Manufacturers:
 - 1. Caddy
 - 2. B-Line

2.10 SUPPORTING DEVICES

- A. Supports, support hardware and fasteners shall be protected with zinc coating or treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic. Products used fin outdoor applications shall be hot dipped galvanized.
- B. Provide clevis hangers, riser clamps, conduit straps, threaded c clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps as applicable.
- C. 14 guage U-Channel systems with 9/16 inch diameter holes at a minimum of 1 7/8 inches on center in the top surface. Provide fittings and accessories that match and mate channel.
- D. Provide carbon steel or wedge or sleeve type expansion anchors, steel springhead toggle bolts and heat-treated steel power driven threaded stud fastening equipment as required by construction types.
- E. Provided field fabricated supporting devices such as angles, channels, pipe supports, etc. All fabricated supports shall be of metal construction as called for in 2.1.

2.11 GROUNDING BARS

- A. Provide telecommunication grounding bar (TGB) assembly as shown on drawings and minimum size of #6 grounding wire from ground bar telecommunications grounding system.
- B. Grounding wire shall be appropriately bonded to the telecommunications main grounding bar (TMGB). The TMGB shall be grounded to the main electrical service grounding electrode system using appropriate rated AWG.
- C. NEMA approved Ground Bar Assembly to be constructed with following materials (See drawing details for additional information):
 - 1. Copper Ground Bar (1/4"x4"x10") with 9/32" holes spaced 1 1/8" apart.
 - 2. Insulators
 - 3. 5/8" Lockwashers
 - 4. Wall Mounting Brackets
 - 5. 5/8-11"x1" HHCS bolts
 - 6. #6 Ground wire THHN 6 STR GRN
- D. Design Make:
 - 1. Chatsworth 10622-010 10" x 4" BUSBAR KIT
- E. Acceptable Manufacturers:
 - 1. Submit

PART 3 EXECUTION

3.1 CONDUIT

- A. All conduit
 - 1. Electrical Metallic Tubing, Rigid Metal Conduit and Rigid PVC are allowed conduit types. Flexible metal conduit is not allowed in sections greater than 5' and must use next larger trade size.

- 2. Install with a minimum of bends and offsets. Bends shall not kink or destroying the interior cross section of the raceway. Bend radius shall be 6 times the internal diameter for conduit sizes up to 2 inches. A conduit greater than 2 inch shall have bend radius at least 10 times the diameter of the conduit.
- 3. Runs exceeding 100 feet or 180 degrees total bends shall be broken with suitable sized pull or splice boxes. (LB or similar conduit fittings are not acceptable)
- 4. Junction boxes or Pull boxes are not to be used for 90 degree bends, Junction boxes and Pull boxes shall be placed in straight sections of conduit.
- 5. Junction Boxes or Pull boxes locations are to be accessible and shall be marked with 1" wide reflective tape.
- 6. All factory or field bends are to be sweeping bends and must maintain conduit capacity.
- 7. Conduit runs to work areas shall serve no more than one (1) communication outlet.
- 8. Secure within three feet of each outlet box, junction box, cabinet or fitting.
- 9. Provide a pull string rated for 200lbs. in all conduit runs to facilitate future installation of cables.
- 10. Conduit shall be installed in the most direct route possible parallel to the building lines.
- 11. Provide conduit supports based on the following table:

| Conduit Trade Size | Type of Run | <u>Horizontal</u> <u>Spacing in Feet</u> | Vertical Spacing in Feet | | |
|--------------------|-------------|---|--------------------------|--|--|
| 1", 1 ¼" | Concealed | 8 | 10 | | |
| 1 ½", & LARGER | Concealed | 10 | 10 | | |
| 1/2", 3/4" | Exposed | 5 | 7 | | |
| 1", 1 ¼" | Exposed | 7 | 8 | | |
| 1 1/2" & larger | Exposed | 10 | 10 | | |

- 12. Where conduits puncture roof, install pitch pockets as required in order that the roof warranty is maintained.
- 13. Conduit System Installation:
 - a) Cable in exterior, above grade locations: Rigid Galvanized Steel
 - b) Interior locations: Electrical Metallic Tubing
 - c) Cable below grade: PVC Schedule 40
- 14. Plug the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.
- 15. All conduits must be clean, dry, and unobstructed and must be capped or plugged upon installation to keep sediment and other debris from clogging the conduits.

- 16. All ends of metallic conduits shall be reamed and all protruding ends must be fitted with bushings at both ends.
- 17. All conduits that pass through fire rated barriers must be properly firestopped upon installation and re-firestopped upon installation of wiring materials.
- 18. As a life safety issue all conduits made of conductive material must be properly grounded and bonded per NFPA 70 and ANSI/TIA/EIA.
- 19. Conduits shall be concealed except in the following areas:
 - a) Mechanical Rooms
 - b) Electric Rooms
 - c) Manufacturing areas
 - d) Garage or maintenance areas
 - e) Unfinished basements or crawl spaces
- 20. Do not install raceways adjacent to hot surfaces or in wet areas.
- 21. When telecommunications pathways penetrate the fire-zone perimeter, any disturbance of the integrity or continuity of the surfaces of a fire-rated barrier needs to be addressed to satisfy code requirements. The methods, materials, and considerations for re-establishing the integrity of fire-rated architectural structures and assembles (floors, walls, and ceilings) required by building codes must be observed.
- B. Building Riser Conduits
 - 1. Conduits, or sleeves from the Building Multifunctional Communications Room (MCR) to each Floor Serving MCR must be vertically stacked or a continuous conduited run.
 - 2. Each Floor Serving MCR must have a conduit/sleeve path to the Building Serving MCR.
 - 3. There must be a minimum of three (3) four inch (4") conduits or sleeves between the Building MCR and each Floor Serving ICR. Additional conduits/sleeves may be required for increased capacity.
 - 4. A nylon (Rope) or plastic (Jet) line with a minimum test rating of 200 lb capacity in all conduits and interduct. Label and tie off rope at both ends to a secure, accessible point.
- C. Conduit fill shall be as follows:

3.2 CONDUIT CAPACITY CHART

| Trade | 2. | Cable Outside Diameter | |
|-------|----|------------------------|--|
|-------|----|------------------------|--|

| | Size | | | | | | | | | | |
|----------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 3.3 | *4.6 | *5.6 | **6.1 | **7.4 | **7.9 | 9.4 | 13.5 | 15.8 | 17.8 |
| Diameter mm | | (0.13) | (0.18) | (0.22) | (0.24) | (0.29) | (0.31) | (0.37) | (0.53) | (0.62) | (0.70) |
| 27 | 1 | 8 | 8 | 7 | 6 | 3 | 3 | 2 | 1 | 0 | 0 |
| 35 | 1 1/4 | 16 | 14 | 12 | 10 | 6 | 4 | 3 | 1 | 1 | 1 |
| 41 | 1 ½ | 20 | 18 | 16 | 15 | 7 | 6 | 4 | 2 | 1 | 1 |
| 53 | 2 | 30 | 26 | 22 | 20 | 14 | 12 | 7 | 4 | 3 | 2 |
| 63 | 2 ½ | 45 | 40 | 36 | 30 | 17 | 14 | 12 | 6 | 3 | 3 |
| 78 | 3 | 70 | 60 | 50 | 40 | 20 | 20 | 17 | 7 | 6 | 6 |
| 91 | 3 ½ | | | | 60 | | | 22 | 12 | 7 | 6 |
| 103 | 4 | | | | 80 | | | 30 | 14 | 12 | 7 |

^{*} Category 5E Cable Diameter Range

3.3 PULL BOX

- A. Must be in easily accessible locations
- B. Be immediately above suspended ceilings where feasible and should be easily identified and labeled.
- C. Equipment, piping, ducts and the like shall not block access to boxes. Provide all necessary junction or pull boxes required due to field conditions and size as required by the National Electrical Code.
- D. The box should have a hinged panel (or equivalent), which can also serve as it's cover.
- E. Are not to be used as splice locations.
- F. Do not use a Pull Box (PB) in lieu of a bend.
 - 1. Align conduits that enter the Pull Box from opposite ends with each other.
- G. PB are to be used in conduit sections are 100 feet or more in length, or contain more than two 90 degree bends, or contain a reverse bend
- H. They are to provide adequate depth and width for fishing, pulling, and looping the cable.
- I. The length must be 12 times the diameter of the largest conduit and in some cases (e g, when large cables are planned to serve multiple work areas), a box length of 16 times the diameter of the largest conduit may be appropriate.

^{**} Category 6 Cable Diameter Range

3.4 SLEEVES

- A. Bond all metallic sleeves back to the MCR's telecommunication ground bar (TGB) that services the cables passing through said sleeves.
- B. Typically three 4 inch sleeves are stacked vertically between MCR. Cable

3.5 TRAYS

A. EXAMINATION

1. Exam areas to receive cable management system. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the system. Do not proceed with installation until unsatisfactory conditions are corrected.

B. INSTALLATION

- 1. Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions.
- 2. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.
- 3. Cutting:
 - a) Cut wires in accordance with manufacturer's instructions.
 - b) Cut wires with side action bolt cutters to ensure integrity of galvanic protective layer.
 - c) Cut each wire with 1 clean cut to eliminate grinding or touch-up.
- 4. Install cable management system using hardware, splice connectors, support components, and accessories furnished by manufacturer.
- C. A minimum of 12" headroom shall be provided above all cable trays.
- D. Provide external grounding strap at expansion joints, sleeves, crossovers and at other locations where tray continuity is interrupted.
- E. Provide necessary elbows, tees, crosses, risers, offsets, fittings, reducers, connectors, clamps, rod suspension, trapeze hangers, etc., as required to make a complete job, coordinate with the manufacturer.
- F. Provide (1) 6" long piece of 3/4" EMT or PVC conduit on each threaded rod hanger to prevent scoring of cable insulation when cable is pulled in.
- G. Cable Trays shall not pass through any firewall or fire-rated soffits unless proper fire stop materials or assemblies for cable tray are used. If not then the cable tray shall end before the firewall and transition to sleeves with connectors and insulated bushings as called for is this specification section. The quantity and size of sleeves shall be of equal or greater capacity as the cable tray being installed.
- H. Cable tray is to be used for Voice, Data and Video cabling only, all other systems cabling shall have separate independent pathways.

3.6 NON-CONTINUOUS CALBE SUPPORT (CABLE HANGERS)

A. Provide cable hangers a maximum of 4' on center wherever cable tray or conduit is not present.

- B. Ceiling ties and rods shall not be used to hang cable or cable supports without the approval of the Owner.
- C. Load hangers as recommended by the manufacturer. Provide hangers side by side on a common bracket where cable quantities require.
- D. Do not install cables loose above lock-in type, drywall or plaster ceilings, conduits must be provided for any section of inaccessible ceiling in excess of a 10' span.
- E. Cables shall be installed at least 3 in. above the ceiling tiles and shall not touch the ceiling.
- F. Do not support cable from ceiling system tie wires or grid in fire rated systems.
- G. Provide a minimum of 2 spare bracket mounted hangers in new construction.
- H. Do not exceed load ratings specified by manufacturer.
- I. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- J. Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

3.7 CONTINUOUS CABLE SUPPORT SYSTEM

- A. Install Continuous Cable Support System using threaded rods attached to support structure or sub structure. Prior to installation, an evaluation of the support structure or sub structure shall be performed by a licensed structural engineer to determine the structure's ability to support the additional load.
- B. Support brackets are to be placed at a maximum distance of 5' apart.
- C. Flexible mesh shall not exceed more then a 12" deflection between support brackets.
- D. A minimum of 12" headroom shall be provided above all Continuous Cable Support System.
- E. Flexible mesh at full defection shall be installed at a minimum of 3 in. above the ceiling tiles and shall not touch the ceiling.
- F. Flexible mesh must be attached to steel support brackets with spring steel bracket clips per manufacturer's specifications.
- G. When connecting flexible mesh sections, overlap per manufacturer's specifications.
- H. Use transition piece for corners and elevation changes in excess of 10 degrees.
- I. Bend transition piece prior to installation of flexible mesh. Maintain bend radius of all cables to be installed in transition piece.
- J. Provide all necessary transitions kits and support kits, clamps, threaded rod suspension, as required to make a complete job, follow all manufacturer requirements.
- K. Continuous Cable Support System shall not pass through any firewall, fire-rated soffits or assemblies. It shall end before the firewall, fire-rated soffits or assemblies and transition to sleeves of equal or greater capacity as the Continuous Cable Support System with connectors and insulated bushings as called for in this specification section. The 4" sleeves shall be part of a Firestop System, which meets applicable local building and fire codes.
- L. Support pathway from building to support structure or sub structure. Do not support pathway from ductwork, piping, or other equipment hangers.

- M. Coordinate all pathway runs with other trades prior to installation.
- N. All pathways shall be installed a minimum of 12 in. away from any light fixture or other source of EMI (Electro-magnetic interference).
- O. All horizontal pathways shall be bonded and grounded per the NEC Article 250 if required by local code or regulation.
- P. In all cases horizontal pathways shall be sized for a minimum of 50% future growth.

3.8 WIREWAYS AND TROUGHS

A. Installation per manufacturers requirements

3.9 POWER/COMMUNICATION POLES

A. Installation per manufacturers requirements

3.10 BOXES AND CABINETS

- A. Consider location of outlets shown on drawings as approximate only. Study architectural, electrical, process piping, mechanical, plumbing, structural, roughing-in, etc., drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between drawings, contact Owner's Representative for decision prior to installation.
- B. Outlet boxes in separate rooms shall not be installed "back-to-back".
- C. Outlet boxes shall be sized to accommodate the conduit and wiring device(s) to be installed.
- D. Outlet boxes installed in plaster, gypsum board or wood paneled walls shall be installed with raised plaster covers or raised tile covers.
- E. Outlet boxes installed in tile, brick or concrete block walls shall be installed with extra-deep type raised tile covers or shall be 3-1/2" deep boxes with square corners and dimensions to accommodate conductors installed.
- F. Surface ceiling mounted outlet boxes shall be minimum 4" square, 1-1/2" deep, galvanized sheet
- G. Surface wall mounted metallic outlet boxes shall be cast type boxes having threaded or compression type threadless hubs. Exterior boxes shall be cast type with threaded hubs and gasketed cover plates secured by non-ferrous screws.
- H. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:
 - 1. Desktop telephone outlets 18"
 - 2. Data outlets 18"
 - 3. Data or desktop telephone outlets, above <u>hot water</u> or <u>steam</u> baseboard heaters. Do not install receptacle outlets above electric baseboard heaters. 30"
 - 4. Television outlet 18"
 - 5. Wall Mounted Phone 48"
 - 6. Bracket Mounted Television 96"

- I. Where structural or other interference prevent compliance with mounting heights listed above, consult Owner's Representative for approval to change location before installation.
- J. Where communications outlets are shown on, behind, below or above furniture or millwork. Verify the exact location and mounting height with the project coordinator.
- K. Pull boxes shall have a distance between each raceway entry inside the box and the opposite wall of the box of at least 6 times the trade-size diameter of the largest raceway, this distance being increased by the sum of the trade size diameters of the other raceways on the same wall of the box and have a distance between the nearest edges of each raceway enclosing the same conductor of at least 6 times the trade size diameter of the raceway or 6 times the trade size diameter of the larger raceway if they are of different sizes.
- L. Install outlet boxes as per sizes indicated on the drawings.
- M. Install Low Voltage Mounting Brackets for fishable wall installation location that does not have an available outlet box.

3.11 SUPPORTING DEVICES

- A. Hangers and Supports:
 - 1. Provide steel angles, channels and other materials necessary for the proper support of wall-mounted cabinets, racks, panels, etc.
 - 2. Cabinets, large pull boxes, and cable support boxes shall be secured to ceiling and floor slab and not supported from conduits. Small equipment boxes, etc., as approved by Owner's Representative, may be supported on walls. Racks for support of conduit and heavy equipment shall be secured to building construction by substantial structural supports.

3.12 GROUNDING AND BONDING

- A. Copper bus provided in each Telecommunication Room.
- B. Follow all EIA/TIA 607 and BICSI standards.

3.13 GENERAL

- A. Support raceways from building construction. Do not support raceways from ductwork, piping, or equipment hangers.
- B. Support outlet, pull, and junction boxes independently from building construction. Do not support from raceways.
- C. Coordinate all raceway runs with other trades.
- D. All open raceways shall be installed a minimum of 6 in. away from any light fixture or other source of EMI (Electro-magnetic interference).
- E. All metallic horizontal pathways shall be bonded and grounded per the NEC Article 250 back to the TGB (Telecommunications Ground Bar).

END OF SECTION 271200

SECTION 271313 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. High-count Category 5 UTP cable.
 - 2. High-count Category 6 UTP cable.
 - 3. UTP cable hardware, including patch panels and cross-connects.
 - 4. Grounding provisions for UTP cable.

1.3 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. LAN: Local area network.
- E. RCDD: Registered Communications Distribution Designer.
- F. UTP: Unshielded twisted pair.

1.4 COPPER BACKBONE CABLING DESCRIPTION

- A. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-C.
- C. Grounding: Comply with TIA-607-B.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications, Plenum Rated: Type CMP complying with UL 1685.

2.3 HIGH-COUNT CATEGORY 5e UTP CABLE

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 2. Belden Inc.
 - 3. General Cable; General Cable Corporation.
 - 4. Mohawk; a division of Belden Networking, Inc.
 - 5. West Penn Wire.
- B. Description: 100-ohm, 24 AWG, 50-pair UTP, plenum-rated cable, covered with a white thermoplastic jacket and overall metallic shield.
 - 1. Comply with ICEA S-90-661, NEMA WC 63.1 and TIA-568-C.2 for Category 5e cables.

2.4 UTP CABLE HARDWARE

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. <u>AMP NETCONNECT; a TE Connectivity Ltd. company.</u>
 - 2. Belden CDT Networking Division/NORDX.
 - 3. CommScope, Inc.
- B. General Requirements for Cable Connecting Hardware:
 - 1. UTP cable hardware shall meet the performance requirements of Category 5e.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.

- c. Replaceable connectors.
- d. 24 or 48 ports.
- 2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
- 3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA-568-C.1.
- C. Factory test UTP cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters. Conceal raceway and cables, except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Div 26.

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF COPPER BACKBONE CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.1.
 - 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM)," Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section Use lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 - 11. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. UTP Cable Installation:

- 1. Comply with TIA-568-C.0 and TIA-568-C.2.
- 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

- 2. Suspend UTP cable, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
- 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
 - 1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-C for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
 - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
 - 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
 - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
 - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271313

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM3).
 - 2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
 - 3. Cabling identification products.

1.3 **DEFINITIONS**

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. IDC: Insulation displacement connector.
- D. LAN: Local area network.
- E. RCDD: Registered Communications Distribution Designer.

1.4 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

- A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

- 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
- 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
- 3. Cabling administration drawings and printouts.
- 4. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
- 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, , installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: Certified by BICSI.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Telecommunications Pathways and Spaces: Comply with TIA-569-C.
- D. Grounding: Comply with TIA-607-B.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM3)

- A. Description: Multimode, 50/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
- B. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 2. <u>CommScope, Inc.</u>
 - 3. Corning Cable Systems.
 - 4. TE Connectivity Ltd.
- C. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
- D. Minimum Overfilled Modal Bandwidth-length Product: 1500 MHz-km at 850 nm; 500 MHz-km at 1300 nm
- E. Minimum Effective Modal Bandwidth-length Product: 2000 MHz-km at 850 nm.
- F. Jacket:
 - 1. Jacket Color: Aqua.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
- G. Comply with ICEA S-83-596 for mechanical properties.
- H. Comply with ICEA S-87-640 for mechanical properties.
- I. Comply with TIA-568-C.3 for performance specifications.
- J. Comply with TIA-492AAAC for detailed specifications.
- K. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - 1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2.2 OPTICAL FIBER CABLE HARDWARE

- A. <a - 1. <u>Belden CDT Networking Division/NORDX.</u>
 - 2. <u>Corning Cable Systems</u>.
 - 3. Optical Cable Corporation.
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- D. Cable Connecting Hardware:
 - Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B for Type ST connectors, TIA-604-3-B for Type SC connectors, TIA-604-10-B for Type LC connectors, TIA/EIA-604-12 for Type MT-RJ connectors, and TIA-604-5-D for Type MPO connectors. Comply with TIA-568-C.3.
 - 2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.25 dB.

2.3 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 301.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.1.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 - 11. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Optical Fiber Cable Installation:
 - 1. Comply with TIA-568-C.3.
 - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- D. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-C, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271323

SECTION 271500 - HORIZONTAL CABLING

PART 1 GENERAL

1.1 Summary

A. SCOPE OF WORK

- 1. Horizontal cabling is the portion of the cabling system that extends from the work area to the MCR. The horizontal cabling shall be configured in a star topology. The horizontal cabling includes the horizontal cables, the mechanically terminated jacks/inserts and the faceplates that the jacks/inserts snap into, in the work area.
- 2. This section includes minimum requirements for the following:
 - a) Horizontal Data cabling:
 - 1) Category 6 UTP Cable from TR to Workstation
 - 2) Category 6 Jacks
 - 3) Category 6 Patch Cables
 - b) Faceplates
 - c) Installation and Termination Methods
- 3. Related Sections include the following:
 - a) 27 1400 Backbone Cabling Requirements

1.2 QUALITY ASSURANCE

- A. All cable shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of KCTCS Network Operations and KCTCS Facility Management. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where "OR EQUIVALENT" is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to acceptance by KCTCS Network Operations and KCTCS Facility Management. Strictly adhere to all Category 6 installation practices when installing UTP data cabling.
- B. Materials and work specified herein shall comply with the applicable requirements of:
 - 1. Panduit Certification Plus certified system requirements
 - 2. ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard
 - 3. ANSI/TIA/EIA 569-A Commercial Building Standard for Telecommunications Pathway and Spaces
 - 4. EIA/TIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - EIA/TIA-607 Commercial Building Grounding and Bonding requirements for Telecommunications
 - 6. NEMA 250
 - 7. Federal Communications Commission 47 CFR 68.
 - 8. BICSI Telecommunications Distribution Methods Manual (9th edition)
 - 9. BICSI Customer Owned Outside Plant Design Manual (2nd edition)
 - 10. BICSI Telecommunications Cabling Installation Manual (2nd edition)
 - 11. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial Building Telecommunications Cabling

- 12. ADA Americans with Disabilities Act
- 13. NFPA 70 2002, including:
 - a) NEC Article 770
 - b) NEC Article 800
- 14. Underwriters Laboratory
- 15. KCTCS Design Guidelines and Specifications

1.3 SUBMITTALS

- A. Manufacturers catalog sheets, specifications and installation instructions for all cable, Category 6 inserts, faceplates and jacks.
- B. If providing pre-standards manufacturer system solution, submit installer/contractor certification documentation and channel certification information and requirements from manufacturer.

PART 2 PRODUCTS

2.1 General

A. Horizontal components (Cable, Jacks, Patch Panels, Equipment / Patch Cables, etc.) for data network cabling shall conform to the following Panduit Certification Plus 25 Year TX System Warranty:

| Parameter (1.0 – 250 MHz) | Requirements |
|--|--|
| Attenuation | 1.88sqrt(f)+0.017(f)+0.2/sqrt(f) |
| Pair-to-Pair Near End Crosstalk (NEXT) | 77.1-16.6log(f/.772) |
| Power Sum NEXT (PS NEXT) | 75.7-16.6log(f/.772) |
| Attenuation Crosstalk Ratio (ACR) | NEXT – Attenuation |
| Power Sum Attenuation Crosstalk Ratio (PS ACR) | PS NEXT – Attenuation |
| Equal Level Far-End Crosstalk (ELFEXT) | 66-20log(f/.772) |
| Power Sum (ELFEXT) | 63-20log(f/.772) |
| Return Loss (RL) | 21 for 1 <f<20 mhz<br="">21-10log(f/20) for f>20 MHz</f<20> |

2.2 100 OHM UNSHIELDED TWISTED PAIR DATA NETWORK CABLE (UTP)

- A. Physical Characteristics:
 - 1. (For Plenum) Shall be plenum rated and meet applicable requirements of ANSI/ICEA S-80-576. All 4 pairs must be insulated with F.E.P. No 2x2 or 3x1 constructions will be allowed.
 - 2. The diameter of the insulated conductor shall be .023 in. maximum.
 - 3. Shall consist of (4) 22-26 AWG twisted pairs.
 - 4. Shall be suitable for the environment in which they are to be installed.
 - 5. The color coding of pairs shall be:

| Pair 1 | W-BL; BL |
|--------|----------|
| Pair 2 | W-O; 0 |
| Pair 3 | W-G; G |
| Pair 4 | W-BR; BR |

- 6. The overall diameter of the cable shall be 0.23 inches or less
- 7. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
- 8. Cable shall withstand a bend radius of 1 inch at -20 degrees Celsius without jacket or insulation cracking.
- 9. Cable shall meet Panduit's 25 year Certification Plus Warranty
- 10. Cable shall meet EIA / TIA 568-B.2-1 standard for Category 6 UTP cable.

B. Transmission Characteristics:

- 1. DC resistance of any conductor shall not exceed 9.38 Ohms per 100m max. at 20°C. Measured in accordance with ASTM D 4566.
- 2. The mutual capacitance of any pair at 1 kHz for 100m of cable shall not exceed 4.4 nF.
- 3. DC resistance unbalance between any two conductors of any pair shall not exceed 5% when measured at or corrected to 20°C in accordance with ASTM D 4566.
- 4. The capacitance unbalance to ground at 1 kHz of any pair shall not exceed 330 pF per 100m.
- 5. Structural return loss swept measurement for 100m or longer shall be meet or exceed the following:

| Frequency (MHz) | Min. SRL (dB) |
|-----------------|---------------|
| 1.0 | 25.0 |
| 4.0 | 25.0 |
| 10.0 | 25.0 |
| 16.0 | 25.0 |
| 20.0 | 25.0 |
| 31.25 | 23.6 |
| 62.5 | 21.5 |
| 100 | 20.1 |
| 155.5 | 18.8 |

| 200 | 18.0 |
|-----|------|
| 250 | 17.3 |

6. The maximum attenuation of any pair shall be less than the following:

| <u>I</u> | Frequency (MHz) | Max. Attenuation (dB) |
|----------|-----------------|-----------------------|
| 1 | 0.0 | 1.7 |
| 4 | 1.0 | 3.5 |
| 1 | 0.0 | 5.4 |
| 1 | 6.0 | 6.9 |
| 2 | 20.0 | 7.7 |
| 3 | 31.25 | 9.8 |
| 6 | 52.5 | 14.0 |
| 1 | .00 | 18.0 |
| 2 | 200 | 25.4 |
| 2 | 250 | 30.4 |

7. The NEXT coupling loss between pairs in a cable shall be greater than or equal to the following:

| Frequency (MHz) | NEXT Loss Worst Pair (dB) |
|-----------------|------------------------------|
| 1.0 | 92.1 |
| 4.0 | 84.5 |
| 10.0 | 79.9 |
| 15.0 | 75 |
| 20.0 | 63.3 |
| 31.25 | 68.3 |
| 62.5 | 60.6 |

| 100 | 58.2 |
|-----|------|
| 200 | 51.9 |
| 250 | 51.9 |

8. The CAT 6 PSNEXT loss @ 20 degrees Celsius ± 3 degrees (68 degrees F ± 5.5 degrees) between pairs in a cable for a length of 100m (328ft) shall bet greater than or equal to the following:

| Frequency (MHz) | PSNEXT Loss Worst Pair (dB) |
|-----------------|--------------------------------|
| 1.0 | 88.8 |
| 4.0 | 81.6 |
| 10.0 | 75.7 |
| 16.0 | 71.4 |
| 20.0 | 69.4 |
| 31.25 | 64.2 |
| 62.5 | 63.0 |
| 100 | 56.2 |
| 200 | 54.0 |
| 250 | 53.8 |

2.3

1. The CAT 6 PSELFEXT loss @ 20 degrees Celsius \pm 3 degrees (68 degrees F \pm 5.5 degrees) between pairs in a cable for a length of 100m (328ft) shall not exceed the following:

| Frequency (MHz) | PS-ELFEXT Worst Pair (dB) | Loss |
|-----------------|------------------------------|------|
| 1.0 | 81.3 | |
| 4.0 | 68.9 | |

| 10.0 | 61.1 |
|-------|------|
| 16.0 | 55.9 |
| 20.0 | 54.9 |
| 31.25 | 50.5 |
| 62.5 | 44.4 |
| 100 | 44.5 |
| 200 | 35.7 |
| 250 | 30.1 |

2. The CAT 6 return loss @ 20 degrees Celsius \pm 3 degrees (68 degrees F \pm 5.5 degrees) between pairs in a cable for a length of 100m (328ft) shall meet or exceed the following

| Frequency (MHz) | Min. RL (dB) |
|-----------------|--------------|
| 1.0 | 25.0 |
| 4.0 | 30.0 |
| 10.0 | 31.0 |
| 16.0 | 29.0 |
| 20.0 | 29.0 |
| 31.25 | 31.0 |
| 62.5 | 25.0 |
| 100 | 20.0 |
| 200 | 18.0 |
| 250 | 26.0 |

- 3. The propagation delay of any pair at 10 MHz shall not exceed 5.7ns/m
- B. Design Make:
 - 1. See KCTCS Approved Materials List
- C. Acceptable Manufacturers:
 - 1. No submission allowed

2.4 CATEGORY 6 JACKS FOR DATA NETWORK CABLING

- A. Physical Characteristics:
 - 1. Jacks shall meet Panduit Certification Plus TX System Warranty requirements.
 - 2. Shall be tested in accordance with ANSI/EIA/TIA-568-B.2-1 for Category 6

- 3. Shall be modular RJ45 jacks that snap into user configurable faceplates meeting durability requirements specified in IEC 603-7. Provide impact resistant faceplates nylon with label indicating TR, patch panel and port number.
- 4. Shall have 8 position, 8 conductor universal modular jack.
- 5. Termination cap is color coded for T568A and T568B wiring schemes.
- 6. Exceeds all ANSI/EIA/TIA-568-B.2-1 Category 6 connector requirements including Powersum, ACR, ELFEXT and Return Loss.
- 7. Can be clearly identified with labels.
- 8. Shall be designed to retain conductor pair twists through a forward motion termination.
- 9. Designed so termination places no localized stress on critical internal components.
- B. Design Make:
 - See KCTCS Approved Materials List
- C. Acceptable Manufacturers:
 - 1. No Submission Allowed

PAtch panels (see section 27 1400)

100 OHM UTP PATCH CABLES for data network cabling

- D. Physical Characteristics.
 - 1. Patch Cable shall meet Panduit Certification Plus certified system requirements
 - 2. Shall have stranded conductors and meet Category 6 performance criteria as defined by TIA 568-B.2-1
 - 3. Shall be ETL tested and approved for Category 6 component compliance.
 - 4. Shall exceed FCC part 68 Subpart F requirements.
 - 5. Lengths required will range from 4' to 20' as specified by customer.
 - 6. Jacket color shall be white unless accepted by KCTCS.
- E. Design Make:
 - 1. See KCTCS Approved Materials List
- F. Acceptable Manufacturers:
 - 1. No submission allowed

2.5 FACEPLATES

- A. Faceplates installed in office area shall be high impact thermoplastic flush mounted design.
- B. Horizontal and Single gang faceplates shall be 0.22" x 2.75" x 4.5".
- C. Faceplates accept Mini-Com copper and fiber modules, designed to snap in and out.
- D. Shall have label with cover to protect labeling and provide easy identification.
- E. Design Make:
 - See KCTCS Approved Materials List
- F. Acceptable Manufacturers:
 - 1. Submission allowed if determined as need
 - 2. All submissions must be accepted by KCTCS Network Operations and KCTCS Facility Management.

2.6 WALL PHONE WALL JACK ASSEMBLY

- A. Shall be constructed of stainless steel
- B. Shall have mounting lugs designed to mate with corresponding telephone base plate or adapter.
- C. Shall mount to single gang outlet box or to wall directly.
- D. Shall be wired to TIA-568B termination sequence.
- E. Design Make:
 - Panduit KWP6
- F. Acceptable Manufacturers:
 - 1. Submission allowed if determined as need
 - All submissions must be accepted by KCTCS Network Operations and KCTCS Facility Management.

PART 3 Execution 1.1 UTP INSTALLATION

A. UTP Cable:

- All cabling shall be installed to meet Panduit Certification Plus certified system channel performance requirements. All wiring concealed in walls or soffits shall be installed in metal conduits.
- 2. All exposed wiring shall be installed in surface raceway.
- 3. All wiring above ceilings shall be installed in cable tray or open top cable hangers.
- 4. Cable above accessible ceilings shall be supported 3' to 5' on center from cable support attached to building structure.
- 5. Do not untwist cable pairs more than 0.5 in. when terminating.
- 6. The Contractor shall be responsible for replacing all cables that do not pass Category 6 requirements.
- 7. Maximum length of any horizontal cable shall be 275 feet. Work area outlets should be located so that the permanent link is not longer than 275 feet.
- 8. Cable shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.
- 9. Leave sufficient cable for 90° sweeps at all vertical drops.
- 10. Leave a minimum of 12" of slack (excess cable) at each jack location. Leave 6'-8' of slack for each cable in the MCR. Neatly dress in excess cable but do not coil, use figure 8 type routing to reduce cross talk potential.
- 11. Maintain the following clearances from EMI sources.
 - a) Power cable 6 in.
 - b) Fluorescent Lights 12 in.
 - c) Transformers 36 in.
- 12. Do not install cable in common cable hangers with phone or speaker cable.
- 13. Do not install Category 6 cable with velcro or tie wraps, lay cable in tray or cable support as to permit limited continuous contact between any 2 category 6 cables running parallel to one another. The purpose of this is to limit the potential of interference and performance degradation.

- 14. Do not install Category 6 cable with more than 110N (25 lbs) pull force, as specified in EIA/TIA and BICSI practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on: long pulls inside conduit, pulls of multiple cables into a single small bore conduit, on conduit runs greater than 100 lineal feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. Use of tensile rated cords (i.e. fishing line) should be used for difficult or questionable pulls to judge to go/no-go condition of the conduit and pulling setup.
- 15. Cables jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper ("shiners") shall be replaced.
- 16. Firestop all opening where cable is installed through a fire barrier.

B. Inserts and Faceplates

- 1. All cables shall be terminated with high density modular jacks that snap into a faceplate mounted on a wall outlet box, surface raceways or power pole.
- 2. Outlet boxes shall be secured to building with mechanical fasteners. Adhesive fasteners are not allowed.
- 3. All extra openings to be filled with blank inserts.
- 4. Terminate cable per EIA/TIA T568B standard pin assignments.
- 5. Locate so that combined length of cables and cords from panel to phone or computer does not exceed 3m.

END OF SECTION 271500

SECTION 271600 - TESTING, IDENTIFICATION, AND ADMINISTRATION

PART 1 - GENERAL

1.1 Summary

A. SCOPE

- 1. This section includes the minimum requirements for the testing, certification administration and identification of backbone and horizontal cabling.
- 2. This section includes minimum requirements for the following:
 - a) UTP testing and testers
 - b) Fiber optic testing and testers
 - c) Labels and Labeling
 - d) Documentation

1.2 QUALITY ASSURANCE

- A. All testing procedures and testers shall comply with applicable requirements of:
 - 1. KCTCS Specified Standards as based on Graybar VIP 2000 certified system permanent link performance requirements
 - 2. KCTCS Specified Standards as based on Graybar VIP Fiber performance requirements
 - 3. ANSI/TIA/EIA 568- D.1-3 Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
 - 4. ANSI/TIA/EIA 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
 - 5. ANSI/TIA/EIA 526-14A Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant.
- B. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA/EIA 606-B Administration Standards.
 - 2. ANSI/TIA/EIA 569-D Pathway and Spaces
 - 3. ANSI/TIA/EIA 568-D.1-3 Telecommunications Cabling Standard.
 - 4. ANSI/TIA/EIA 758-B Customer Owned Outside Plant Telecommunications Cabling Standard
 - 5. BICSI Telecommunications Cabling Installation Manual
 - 6. BICSI Telecommunications Distribution Methods Manual
 - 7. KCTCS Design Guidelines and Specifications

1.3 SUBMITTALS

- A. Manufacturers catalog sheets and specifications for fiber and copper cable testers.
- B. Test reports

PART 2 PRODUCTS

2.1 **OPTICAL FIBER CABLE TESTER**

A. Multimode optical fiber tester

- 1. Shall be capable of testing to TIA 568-D.1-3 and ANSI/TIA/EIA 526-14A criteria.
- 2. Shall meet the launch requirements of ANSI/EIA/TIA-455-50B.
- 3. Provide VCSEL light sources for testing at 850nm.
- 4. Provide FP laser light sources for testing at 1310nm
- 5. Shall measure length and loss for up to 5000 meters.
- 6. Shall measure to ensure Gigabit Ethernet standards are met.
- 7. Connector types shall include: LC and SC
- B. Design Make:
 - 1. See KCTCS Approved Materials List
- C. Acceptable Manufacturers:
 - 1. Submit
- D. Single mode optical fiber tester (If required)
 - 1. Shall be capable of testing to TIA 568-D.1-3 criteria.
 - 2. Shall meet the requirements of ANSI/TIA/EIA 526-7.
 - 3. Shall provide dual fiber loss testing at both 1300nm and 1500nm wavelengths.
 - 4. Laser light sources shall be used and shall be the same
 - 5. Output Stability +/- 0.40 dB from 0 to 50 degrees C
 - 6. Long Term output stability +/- 0.10dB at 25 degrees C
 - 7. Power shall be from rechargeable Ni-Cad batteries
 - 8. Connector types shall include SC and LC
- E. Design Make:
 - 1. See KCTCS Approved Materials List
- F. Acceptable Manufacturers:
 - 1. Submit
- G. Optical Time Domain Reflectometer (OTDR) Option if Fluke DSX tester not used.
 - 1. Shall be capable of testing to TIA 568-D.1 criteria.
 - 2. Shall have a front CRT display
 - 3. Connector types shall include: SC and LC
 - 4. Design Make:

2.2 Copper cable TESTER (UTP)

- A. Shall be a hand held test unit verified LEVEL III.
- B. Shall be pre-programmed for selection to test to KCTCS Specified parameters as based on Graybar VIP 2000 requirements.
- C. Shall have auto-testing to determine if cable meets the requirements of testing to the following standards:
 - 1. TIA Category 3 and 5E per Addendum #5 to TIA/EIA-568D
 - 2. TIA Category 5 (new) per TIA TSB-95
 - 3. TIA Category 6 per TIA Addendum #1 to TIA/EIA-568D
 - 4. ISO/IEC 11801 Class C and D

- 5. ISO/IEC 11801-2000 Class C and D
- 6. STP cabling, (IBM Type 1, 150 \square)
- 7. ANSI TP-PMD
- 8. IEEE 802.3 10BASE5, 10BASE2
- 9. IEEE 802.5
- D. Shall support the following tests (Range of test is determined by network or selected standard):
 - 1. NEXT, NEXT @ Remote Wire Map
 - 2. Characteristic Impedance Length
 - 3. DC Loop Resistance
 - 4. Propagation Delay
 - 5. Return Loss (RL), RL @ Remote
 - 6. Delay Skew
 - 7. Attenuation
 - 8. Attenuation-to-Crosstalk Ratio (ACR), ACR @ Remote
 - 9. Power Sum ACR, PSACR @ Remote
 - 10. ELFEXT, ELFEXT @ Remote
 - 11. Power Sum ELFEXT, PSELFEXT @ Remote
 - 12. Power Sum NEXT, PSNEXT @ Remotw
- E. Design Make:
 - 1. See KCTCS Approved Materials List
- F. Acceptable Manufacturers:
 - 1. Submit

2.3 LABELS

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or laser printed type.
- C. Where used for cable marking provide vinyl substrate with a white printing area and a wrap around label that self laminates around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow so that the labels are easily distinguishable.
- D. Where insert type labels are used provide clear plastic cover over label.
- E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18" above all direct buried services, underground conduits and duct-banks
- F. Design Make:
 - 1. See KCTCS Approved Materials List
- G. Acceptable Manufacturers:
 - 1. Submit

PART 3 - EXECUTION 3.1 OPTICAL FIBER CABLE TESTING

- A. Test all fibers with launch and far end cable of sufficient length for the OTDR to be able to see through all installed connectors.
- B. Localized attenuation shall not exceed 0.5 dB at any point.
- C. Backbone multimode fiber shall be tested at both 850nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A method B.
- D. Backbone single mode fiber shall be tested in at both 1310nm and 1550 nm in accordance with ANSI/EIA/TIA-526-14A method A.1.
- E. Multimode fiber shall conform to the following:

850 nm:

| Length (meters) | Attenuation (dB) |
|-----------------|------------------|
| 500 | 3.25 |
| 1000 | 5.0 |
| 1500 | 6.5 |
| 2000 | 8.5 |

1300 nm:

| Length (meters) | Attenuation (dB) |
|-----------------|------------------|
| 500 | 2.2 |
| 1000 | 3.0 |
| 1500 | 3.8 |
| 2000 | 4.5 |

F. Single Mode Fiber shall conform to the following (note: taken at 1550nm)

Inside:

| Length (meters) | Attenuation (dB) |
|-----------------|------------------|
| 500 | 2.0 |
| 1000 | 2.5 |
| 1500 | 3.0 |
| 2000 | 3.5 |
| 2500 | 4.0 |

4.5

3000

Outside:

| Length (meters) | Attenuation (dB) |
|-----------------|------------------|
| 500 | 1.8 |
| 1000 | 2.0 |
| 1500 | 2.2 |
| 2000 | 2.5 |
| 2500 | 2.8 |
| 3000 | 3.0 |

KCTCS Specified Fiber Standard

| Standards Body | Document Number | OM1 | OM2 | ОМ3 | OM4 |
|--|--------------------|---|---|---|---|
| International Standards Organization (ISO) | ISO/IEC 11801 | Legacy fibers with a Legacy fibers with a nominal 200/500 nom MHz.km OFL* BW at MHz. 850/1300 nm 85 (no specification of core (no specification of core) | | Type OM2 fiber; egacy fibers with a nominal 500/500 MHz.km OFL BW at 850/1300 nm specification of core meter but typically 50 µm) Type OM3 fiber: Laser optimized 50 µm fibers with 2000 MHz.km EMB** at 850 nm | |
| International Eletrotechnical Commission (IEC) | IEC 60793-2-10 | Type A1b fiber: Legacy 62.5/125 fibers with a range of bandwidth values: 100 - 800 MHz.km OFL at 850 nm 200 - 1000 MHz.km OFL at 1300 nm | Type A1a.1 fiber: Legacy 50/125 fibers with a range of bandwidth values: 200 - 800 MHz.km OFL at 850 nm 200 - 1200 MHz.km OFL at 1300 nm | Type A1a.2 fiber: Laser Optimized 50/125 fibers with 2000 MHz.km EMB at 850 nm 500 MHz.km OFL at 1300 nm | Type A1a.3 fiber: Laser Optimized 50/125 fibers with 4700 MHz.km EMB at 850 nm 500 MHz.km OFL at 1300 nm |
| Telecommunications Industry Association, part of the Electronics Industries Alliance (TIA/EIA) | | 492AAAA: Defines legacy 62.5/125 fibers with 160/500 MHz.km OFL BW at 850/1300 nm | 492AAAB: Defines legacy 50/125 fibers with 500/500 MHz.km OFL BW at 850/1300 nm | 492AAAC: Defines laser-optimized 50/125 fibers with 2000 MHz,km EMB at 850 nm | 492AAAD: Defines laser-optimized 50/125 fibers with 4700 MHz.km EMB at 850 nm |

| Fiber Type Wavelength (nm) | Max Attenuation Coefficient (dB/km) | Bandwidth (MHz-k overfilled laun |
|----------------------------|-------------------------------------|-------------------------------------|
|----------------------------|-------------------------------------|-------------------------------------|

| - 1 | | | | |
|-----|-----------------------|------|-----|----|
| | Singlemode (OS1, OS2) | 1310 | 1.0 | NA |
| | (Premises) | 1550 | 1.0 | NA |
| | Singlemode (OS1, OS2) | 1310 | 0.5 | NA |
| | (Outside Plant) | 1550 | 0.5 | NA |

3.2 100 OHM UTP CABLE TESTING

- A. The testing parameters called for in this section shall include the horizontal Channel for all installed drop locations.
- B. Test cable with test set to match the NVP for the cable as stated by the cable manufacturer of the cable being installed.
- C. The test parameters shall include Wire Map, Length, Attenuation, PS-NEXT, PS-ACR, PS-ELFEXT and Return-Loss
- D. Wire Map
 - 1. The wire map test shall verify pair to pin termination at each end and check for connectivity errors. The wire map shall indicate the following for each of the eight conductors:
 - a) Continuity to the remote end
 - b) Shorts between any two or more conductors
 - c) Crossed pairs
 - d) Reversed Pairs
 - e) Split Pairs
 - f) Any other miss wiring
- E. Cable Channel Performance
 - 1. Must meet the minimum acceptable values as indicated in TIA/EIA 568D.1-3 Category 6 requirements.

| Parameter (1.0 – 250 MHz) | Requirements |
|--|--|
| Attenuation | 1.88sqrt(f)+0.017(f)+0.2/sqrt(f) |
| Pair-to-Pair Near End Crosstalk (NEXT) | 77.1-16.6log(f/.772) |
| Power Sum NEXT (PS NEXT) | 75.7-16.6log(f/.772) |
| Attenuation Crosstalk Ratio (ACR) | NEXT – Attenuation |
| Power Sum Attenuation Crosstalk Ratio (PS ACR) | PS NEXT – Attenuation |
| Equal Level Far-End Crosstalk (ELFEXT) | 66-20log(f/.772) |
| Power Sum (ELFEXT) | 63-20log(f/.772) |
| Return Loss (RL) | 21 for 1 <f<20 mhz<br="">21-10log(f/20) for f>20 MHz</f<20> |

2. Must meet all Panduit Certification Plus test result requirements (Not Vender Specific)

3.3 BACKBONE COPPER CABLING (VOICE)

A. The Contractor shall test all high count copper cables for continuity and submit test results.

3.4 IDENTIFICATION & LABELING

A. Confirm specific labeling requirements with customer's project coordinator prior cable installation or termination.

B. Cables

- 1. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID, sheath ID and strand or pair range.
- 2. Horizontal cables shall be marked at each end, on the sheath indicating the MCR room (#), Equipment rack (#), patch panel (alpha) and panel port (#) to which the cable is wired.

C. Jacks

1. All TX6 WAO and MCR Jacks shall be labeled indicating the patch panel (alpha) and panel port (#) to which the jack is wired. All faceplates and patch panels shall be labeled indicating the MCR room (#), Equipment rack (#) to which the cables are wired.

D. Faceplates and Patch Panels

- 1. Optical Fiber Patch Panels
 - a) Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it.
 - b) Each port shall be labeled with the origination and destination MCR and the individual strand ID.

2. CAT 6 Patch Panels

- a) Shall be labeled as noted on the drawings, individual ports shall come labeled from the factory with a number designation.
- 3. Faceplates
- 4. Shall be labeled indicating the MCR room (#), Equipment rack (#) to which the cables are wired. All TX6 Jacks shall be labeled indicating the patch panel (alpha) and panel port (#) to which the jack is wired.

3.5 RECORD COPY AND AS - BUILT DRAWINGS

- A. Provide record copy drawings periodically through out the project or as requested by the project manager and at end of the project. Record copy drawings shall include notations reflecting the as built conditions of any additions to or variation from the drawings provided.
 - 1. Must indicate locations and reference information (unique cable identifiers) for all work area outlets, junction boxes, and all telecommunication rooms.
 - 2. Must indicate building address, floor number(s), and locations within the floor and directions arrows (North, South).
 - 3. Must include a legend box, which shows the designated standard classification for each link and the specific component and cable part numbers used for the link.
 - 4. Electronic and Hardcopies are required.
 - 5. All work area outlets and telecommunication rooms must be shown or referenced on each floor.
 - 6. Designated standard classification for each link and the specific component and cable part numbers used for the link can be submitted as a separate attachment.

3.6 TEST RESULTS (ADMINISTRATIVE REQUIREMENTS)

A. Horizontal Copper Cabling

- a) Each certified test report must clearly indicate:
 - 1) Date the test was conducted.
 - 2) The designated link or channel performance level (i.e. Class C, Category 6, Class D) and the link configuration (perm link or channel).
 - 3) A link identifier.
 - 4) A "PASSED" test result for the overall test requirements specified in the Commercial Building Telecommunications Cabling Standards for each designated link and/or channel classification.
 - 5) The installation project name.
 - The test equipment manufacturer, test equipment model, test equipment serial number and test equipment adapter cord.

B. Format of tests

- a) A certified passing test report is one that has been signed by the Installer. The Installers signature is his verification that the test results verify compliance with the designated performance requirement as specified in the Commercial Building Telecommunications Cabling Standards and this agreement. Each test report disk or email submitted for a proposed installation must be signed by a representative of the Installation company (emailed documents count as a signature from the sender).
- b) Test reports generated by standard field test equipment must list all necessary performance results as specified in Commercial Building Telecommunications Cabling Standards for the designated link or channel performance level (i.e. Category 5e, Class C, Category 6, Class D).
 - 1) Disk copy is preferred but must be in acceptable format (Field Tester Manufacturers' standard file format).
 - 2) Each test report must contain a clear distinct designated link/channel classification (i.e. Cat. 5e Perm Link, Cat 5e Channel, Multi-mode Basic link). No alternate or added descriptions (such as 350, extend, level 6, level 7) will be accepted. If the designated link/channel classification is preceded by an "*" (asterisk) or contains alternate and/or added descriptions, then the test reports are considered unaccepted by Panduit. (Not Vender Specific)
 - 3) Each optical fiber link test report must include both attenuation and length in order to verify compliance to the cabling standards.
 - 4) Test reports must be submitted in original field tester file format.
 - 5) Optional forms provided may be used to submit reference information.

C. Fiber Optic Cables

- a) The Contractor shall test all fiber optic cables and submit all fiber test result data in an electronic format and provide one (1) hard copy of the test results showing graphically, the entire length of the fiber.
 - Reports shall show circuit ID, cursor marks, total attenuation, date of installation and test used.
- b) Contractor shall submit (1) copy of software capable of viewing the electronic test result files.
- 2. High Pair Count Copper Cables

- a) The Contractor shall test all high count copper cables for continuity and submit test result information in an electronic format. Minimal acceptable formats are Word or Excel.
- b) Format for test report documentation as follows:

| BACKBONE COPPER CABLE TEST RECORDS | | | | | | | | |
|------------------------------------|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Cable Numb | er Cable Count Date | | | | | | | |
| | : Tested To: | | | | | | | |
| Tested From | : | | | Tested To: _ | | | | |
| Tested By: _ | | | | Comp | any | | | |
| | | | | | | | | |
| | D: 1 1 | I | D: 1 1 | | D: 1 1 | | D: 1 1 | |
| | Binder color | | Binder color | | Binder color | | Binder color | |
| Pair Color | Pair # | Test Results | Pair # | Test Results | Pair # | Test Results | Pair # | Test Results |
| BL-W | 1 | | 26 | | 51 | | 76 | |
| O-W | 2 | | 27 | | 52 | | 77 | |
| GR-W | 3 | | 28 | | 53 | | 78 | |
| BR-W | 4 | | 29 | | 54 | | 79 | |
| SL-W | 5 | | 30 | | 55 | | 80 | |
| BL-R | 6 | | 31 | | 56 | | 81 | |
| O-R | 7 | | 32 | | 57 | | 82 | |
| GR-R | 8 | | 33 | | 58 | | 83 | |
| BR-R | 9 | | 34 | | 59 | | 84 | |
| SL-R | 10 | | 35 | | 60 | | 85 | |
| BL-BK | 11 | | 36 | | 61 | | 86 | |
| O-BK | 12 | | 37 | | 62 | | 87 | |
| GR-BK | 13 | | 38 | | 63 | | 88 | |
| BR-BK | 14 | | 39 | | 64 | | 89 | |
| SL-BK | 15 | | 40 | | 65 | | 90 | |
| BL-Y | 16 | | 41 | | 66 | | 91 | |
| O-Y | 17 | | 42 | | 67 | | 92 | |
| GR-Y | 18 | | 43 | | 68 | | 93 | |
| BR-Y | 19 | | 44 | | 69 | | 94 | |
| SL-Y | 20 | | 45 | | 70 | | 95 | |
| BL-V | 21 | | 46 | | 71 | | 96 | |
| O-V | 22 | | 47 | | 72 | | 97 | |
| GR-V | 23 | | 48 | | 73 | | 98 | |
| BR-V | 24 | | 49 | | 74 | | 99 | |
| SL-V | 25 | | 50 | | 75 | | 00 | |

| RECORD TEST RESULTS ABBREVIATIONS TO USE ARE AS FOLLOWS: | | | |
|--|----------|---|--|
| 1) Pair is Good | = OK | 6) Shorted Pair = S.P. | |
| 2) Ring Side Open | = R.S.O. | 7) Split Pair = SPL | |
| 3) Tip Side Open | = T.S.O. | (ex. For tip side of #5 and #17 = T. of #5 w/ T. of | |
| | | #17) | |
| 4) Ring Ground | = R.G. | 8) Reverse Sides = REV | |
| 5) Tip Ground | = T.G. | | |

END OF SECTION 271600

SECTION 271700 - SUPPORT AND WARRANTY

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.
- B. Provide Vender Certification Plus 25 Year Manufacture Solution System Warranty Certificate at completion.
- C. Provide all other warranty documentation as required.

1.2 SCOPE

- A. This section includes:
 - 1. Post Cutover Support Requirements
 - 2. Warranty Requirements

1.3 Submittals

- A. Submit all manufacturer warranty information with bid
- B. Submit Contractor certification to provide Vender Certification Plus 25-year Manufacture Solution Warranty with bid.

PART 2 PRODUCTS

2.1 DATA NETWORK CABLE SYSTEM

- A. Horizontal Channel Components
 - 1. System shall meet Vender Certification Plus 25 Year Category 6 Manufacture Solution System requirements.
 - 2. Includes: 25-year standards-based performance warranty.
- B. Optical Fiber Cable
 - 1. Includes: 15-year standards-based performance warranty.

2.2 VOICE NETWORK CABLE

- C. Interior High Pair Count Copper
 - 1. System shall meet manufacturer certification requirements.
 - 2. Includes: 10-year warranty

PART 3 EXECUTION

3.1 SUPPORT

- A. Contractor shall provide technician as needed on site calls for a period of 12 months for installation warranty work.
- B. Activities shall include, but will not be limited to:
 - 1. Additional cabling on per cost basis unless warranty related
 - 2. Changes to the cable plant on per cost basis unless warranty related
 - 3. Moving installed cables on per cost basis unless warranty related
 - 4. Additional or Ongoing training as needed

- C. Contractor shall respond to "customer determined emergencies" within four (4) hours of receiving request for service and if required have a technician onsite within one business day.
- D. This emergency response requirement shall be in effect for the duration of the 12-month installation system warranty.

3.2 WARRANTY

- E. Submit all required documentation to manufacturer for warranty certifications.
- F. Provide all required documentation for all warranties as stated in this section to owner at project completion.

END OF SECTION 271700

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electronic safety and security equipment coordination and installation.
 - 2. Common electronic safety and security installation requirements.

1.3 **DEFINITIONS**

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

PART 2 - EXECUTION

2.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 280500

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Notification appliances.
 - 5. Device guards.
 - 6. Magnetic door holders.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.

1.3 **DEFINITIONS**

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.
- F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, details, and attachments to other work.

- 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
- 4. Detail assembly and support requirements.
- 5. Include input/output matrix.
- 6. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
- 7. Include performance parameters and installation details for each detector.
- 8. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
- 9. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring required for HVAC unit shutdown on alarm.
 - c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
 - d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
 - e. Locate detectors according to manufacturer's written recommendations.
 - f. Show air-sampling detector pipe routing.
- 10. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
- 11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

- 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect. Provide all required submittals and include all costs in bid.
- 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria.
 - 1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
 - 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 - 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

- 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - g. Record copy of site-specific software.
 - h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - i. Manufacturer's required maintenance related to system warranty requirements.
 - j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
- C. Provide certification report of completed system.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to [10] percent of amount installed, but no fewer than one unit of each type.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 - 3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
 - 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
 - 5. Keys and Tools: One extra set for access to locked or tamperproofed components.
 - 6. Audible and Visual Notification Appliances: One of each type installed.

7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission andhorn/strobe evacuation.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Smoke detectors.
 - 3. Duct smoke detectors.
 - 4. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Release fire and smoke doors held open by magnetic door holders.
 - 5. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 6. Activate preaction system.
 - 7. Recall elevators to primary or alternate recall floors.
 - 8. Activate elevator power shunt trip.

- 9. Record events in the system memory.
- 10. Record events by the system printer.
- 11. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. User disabling of zones or individual devices.
 - 3. Loss of communication with any panel on the network.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4. Loss of primary power at fire-alarm control unit.
 - 5. Ground or a single break in internal circuits of fire-alarm control unit.
 - 6. Abnormal ac voltage at fire-alarm control unit.
 - 7. Break in standby battery circuitry.
 - 8. Failure of battery charging.
 - 9. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. System Supervisory Signal Actions:
 - 1. Initiate notification appliances.
 - 2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
 - 3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.3 FIRE-ALARM CONTROL UNIT

- A. <u>Manufacturers:</u> Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - 2. Gamewell FCI by Honeywell.
 - 3. Notifier.
 - 4. Silent Knight.
- B. General Requirements for Fire-Alarm Control Unit:
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.

- e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
- Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
- 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1. Serial Interfaces:
 - One dedicated RS 485 port for central-station or remote station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One USB port for PC configuration.

E. Smoke-Alarm Verification:

- 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
- 2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
- 3. Record events by the system printer.
- 4. Sound general alarm if the alarm is verified.
- 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

- 1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
- 2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
- 3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:

- 1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
- 2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.

- H. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
- L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be four-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

- 7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.
 - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Multiple levels of detection sensitivity for each sensor.
 - d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

- 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
- 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

- 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
- 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
 - 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
 - 4. Each sensor shall have multiple levels of detection sensitivity.
 - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-(25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, red.

2.7 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - 1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
 - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 - 3. Rating: 24-V ac or dc.
 - 4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

2.8 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 ADDRESSABLE INTERFACE DEVICE

A. General:

- 1. Include address-setting means on the module.
- 2. Store an internal identifying code for control panel use to identify the module type.
- 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall or to circuit-breaker shunt trip for power shutdown.
 - 1. Allow the control panel to switch the relay contacts on command.
 - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

- 1. Operate notification devices.
- 2. Operate solenoids for use in sprinkler service.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Unit shall not be integral to the fire alarm panel. Acceptable manufacturers include but are not limited to:
 - 1. Silent Knight
 - 2. Hubbell
 - 3. Leviton
- C. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- D. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- E. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply.

- 5. Loss of power.
- 6. Low battery.
- 7. Abnormal test signal.
- 8. Communication bus failure.
- F. Secondary Power: Integral rechargeable battery and automatic charger.
- G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:
 - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet (9 m).

- 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex Ain NFPA 72.
- 5. HVAC: Locate detectors not closer than 36 inches ((910 mm)) from air-supply diffuser or returnair opening.
- 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install at 80" AFF or 6" below ceiling, whichever is lower. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- J. Visible Alarm-Indicating Devices: Install at 80" AFF or 6" below ceiling, whichever is lower. Install all devices at the same height unless otherwise indicated.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

- A. Pathways shall be installed in concealed EMT.
- B. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.
 - 2. Magnetically held-open doors.
 - 3. Electronically locked doors and access gates.
 - 4. Alarm-initiating connection to elevator recall system and components.

- 5. Supervisory connections at valve supervisory switches.
- 6. Supervisory connections at elevator shunt-trip breaker.
- 7. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

3.8 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Upgrade Service: At Substantial Completion, update software to latest version

3.9 **DEMONSTRATION**

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.10 CENTRAL STATION MONITORING

A. Provide a one-year contract with a UL listed central monitoring station to monitor the fire alarm system. Include all costs and programming. One-year contract is to start at date of substantial completion.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.
- C. Removal of existing site improvements including pavements, utilities and utility structures, foundations or other site improvements.

1.02 RELATED REQUIREMENTS

- A. Section 011000 Summary: Limitations on Contractor's use of site and premises.
- B. Section 015000 Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 015713 Temporary Erosion and Sediment Control.
- D. Section 017000 Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- E. Section 312200 Grading: Topsoil removal.
- F. Section 312323 Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- G. Section 312513 Permanent Erosion Controls
- H. Section 311500- Protection of Existing Trees

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: As specified in Section 312323 - Fill and Backfill

PART 3 EXECUTION

3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 017000.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.
- E. Pavements and slabs are to be saw cut to provide a clean edge. Concrete pavements are to be cut at the nearest control joint to the required demolition area.

SITE CLEARING 311000 - 1

3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, planting beds, borrow areas (when applicable) and disposal areas (when applicable).
- B. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits.
 - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
 - 3. Around other vegetation to remain within vegetation removal limits.
- C. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
 - 3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- D. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SITE CLEARING 311000 - 2

SECTION 311500 - PROTECTION OF EXISTING TREES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Protection of existing trees is to be performed on the project site and at any areas adjacent to or near the site where construction activities impact the Tree Protection Zone (TPZ). Tree protection will function as follows:
 - 1. The foliage canopy and branching structure are to be kept clear from contact with equipment, vehicles, materials and activities
 - 2. The roots and soil conditions are to be preserved in an intact and non-compacted state
 - 3. No Soil disturbance is permitted within the identified Tree Protection Zone (TPZ) unless otherwise approved.
- B. Work included: Furnish all labor, materials, equipment and services necessary to protect existing trees on site and on adjacent road right-of-way and sites, including but not limited to:
 - 1. Survey and layout, installation, maintenance, adjustment during construction, and final removal of protective barriers and signs.
 - 2. Pruning as required, including hand excavation and root pruning if required and approved by the landscape architect and/or arborist.
 - 3. Excavation, soil stabilizing

1.02 RELATED REQUIREMENTS

- A. Section 011000 Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.
- B. Section 013000 Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- C. Section 015713 Temporary Erosion and Sedimentation Control.
- D. Section 024100 Demolition: Selective demolition, site demolition, structure removal.

1.03 DEFINITIONS AND PROCEDURES

- A. Tree Protection Zone (TPZ) (May be interchanged with Critical Root Zone (CPZ) and Drip-Line below): An area around the base of a tree with a radius of 10 times the diameter of the tree's trunk or twenty feet, whichever is greater.
- B. Tree Protection Barrier: any fencing or other barrier material, including supports and bracing for such, to be used to surround and enclose the TPZ.
- C. Critical Root Zone Area (CRZ): The area of undisturbed natural soil around a tree defined by a horizontal circle drawn at grade with the trunk at the center and extending for a radial distance equal to the distance from the center of the trunk to the outermost portion of the drip line.
- D. Drip Line: the area surrounding a tree directly below the outermost portions of the tree canopy, or a circular area with a radius of one-half of the height of the tree extending outward from the center point of the tree.
- E. Warning Sign: A warning sign is to be prominently displayed on each fence at 25- foot intervals.
- F. Root Protection: Materials or devices installed at ground level to protect the root system of trees from compaction during construction.
- G. Root Boring for utility installation: Directional micro-tunneling and boring may be permitted within the limits of the TPZ subject to approval by the Landscape Architect.
- H. Tree Topping: Practice of removing a substantial portion or all of the upper canopy of a tree. Tree Topping will not be allowed in this project.

I. Root Boring: Boring beneath protected trees to provide a tunnel for the installation of utilities.

PART 2 PRODUCTS

2.01 TREE PROTECTION PRODUCTS

- A. Fencing: 4'-0" high orange plastic 'snow' or barrier fence. Provide steel posts spaced at 6 ft. minimum.
- B. Tree Protection Area Signs: minimum size 12" x 18", may be lettered vertically or horizontally.
 - 1. Size: minimum 12" x 18", vertical or horizontal placement.
 - 2. Text: CAUTION TREE PROTECTION ZONE DO NOT REMOVE. NO DUMPING, BURNING, STORAGE, CUTTING, MACHINERY OR VEHICLES.
 - 3. Material to be painted plywood or other weather resistant material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to the beginning of demolition or construction work, field verify the TPZ for each existing tree to be preserved. Perform any root exploratory excavation necessary to determine root location and condition and/or other existing conditions.
- B. Instruct all construction workers to observe the TPZ limits.

3.02 INSTALLATION

- A. No construction activity including grade changes, surface treatments or excavations of any kind is permitted within the TPZ of any existing tree to remain unless otherwise indicated on the project plan drawings. The area within the TPZ must remain undisturbed at all times.
- B. No root cutting is permitted unless done with the approval of the landscape architect and requiring the services of a qualified arborist or approved tree professional. An exploratory excavation by hand or using a low water pressure hydro vac method must be completed prior to commending with open face cuts outside the TPZ.
- C. Do not store materials or fill within the TPZ.
- D. Do not allow movement, parking or storage of vehicles or equipment within the TPZ.
- E. Do not discharge exhaust into foliage or allow fires under and adjacent to trees.
- F. Do not allow run off of spillage of damaging materials into the TPZ, including but not limited to concrete overflow or sleuth, gas, oil, paint, etc.
- G. Fencing is to be placed around all trees marked to remain located within the area of distrubance.
- H. Protection Barrier Fencing Layout:
 - 1. Typical Layout: Fencing is to enclose the entire area under the canopy drip line or TPZ (whichever is greater) of each tree or group of trees to be protected throughout the demolition and construction period.
 - 2. Special Layout:
 - a. For trees located within a planting strip or island, and where existing vehicular and/or pedestrian pathways must be kept open for use, only the planting strip or island and landscaped side of the TPZ is to be enclosed with the required fencing type.
 - b. For trees located in a tree well or sidewalk planter pit, the tree is to be wrapped with 2 inches of orange plastic fencing from the ground to the height of the first branch and overlaid with 2 inch thick wooden slats bound securely. Protect the tree bark

from direct contact with the slats. Use caution during installation to avoid damage to branches and tree stem.

- I. Install Tree Protection Barrier Fencing
 - 1. Orange safety fence: Embed posts a minimum 18 inches at no more than 5 (five) foot spacing. Fencing is to be tied closed completely surrounding the TPZ.
- J. Install Tree Protection Area and Enclosure Signage.
- K. Water retained trees thoroughly and deeply as necessary to supplement rainfall to maintain plant turbidity without prolonged saturation of the root zone. The method, amount and frequency of watering is to be per the recommendation of the arborist. Monitor soil moisture on a continual basis.
- L. Retained trees may require fertilizing and other measures to stimulate regeneration of lost roots and foliage. Fertilization and other measures are to be per the recommendation of the arborist.
- M. Tree Topping: No Tree Topping will be allowed.
- N. Tree Pruning: Branches which are found to be a barrier to construction or a health and safety hazard may be removed subject to the approval of the landscape architect/arborist.
 - 1. When removing a branch, cut outside the branch bard ridge and collar. Do not make a flush cut adjacent to the trunk of the tree or branch being pruned.
 - 2. Make a partial cut from beneath at a point several inches away from the trunk.
 - 3. Make a second cut from above several inches out from the first cut to allow the limb to fall safely.
 - 4. Complete the removal with a final cut just outside the branch collar (the raised area that surrounds the branch where it joins the trunk).
 - 5. Make all cuts clean and remove any jagged edges carefully.

3.03 INTERFACE WITH OTHER WORK:

A. Coordinate tree protection with all demolition, excavation and utility work in the area...

3.04 FIELD QUALITY CONTROL

- A. See Division 1 for Quality Requirements.
- B. Inspect for existing soil conditions which may be detrimental to tree health and survival; existing utilities within or adjacent to the TPZ; and extent of root system beyond the visible drip line.
- C. Any trees which are found to be in poor or damaged condition are to be evaluated by the landscape architect or arborist. Trees that are deemed to have a minimal chance of survival or which pose a health or safety risk may be removed or pruned by more than one-third subject to approval of the landscape architect/arborist and Owner.

3.05 MAINTENANCE

- A. See Division 1 for additional requirements relating to maintenance service.
- B. Trees are to be watered, aerated and maintained as necessary to ensure survival.
- C. Repair or replace any fencing, ground protection or signage that has been removed or damaged. Inspect installations on a continuous basis.
- D. Tree protection devices are to be removed at the end of the project (after final completion) and the area beneath the TPZ returned to original condition.

END OF SECTION

SECTION 312200 - GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removal of topsoil.
- B. Rough grading the site for site structures.
- C. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 015713 Temporary Erosion and Sediment Control.
- B. Section 311000 Site Clearing.
- C. Section 312316 Excavation.
- D. Section 312316.13 Trenching: Trenching and backfilling for utilities.
- E. Section 312323 Fill: Filling and compaction.
- F. Section 312513 Permanent Erosion Controls
- G. Section 329219 Seeding: Finish ground cover.
- H. Section 329223 Sodding: Finish ground cover.

1.03 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 DEFENITIONS

- A. Finish Grade Elevations: Indicated on Drawings
- B. Zone of Influence: Area beneath a footing or foundation that extends out from the bottom edge of the footing/foundation at a 45-degree angle down to a depth equal to 3 times the footing width.
- C. Fat Clays: Soil types with the classification of CH and a Plasticity Index (PI) above 30%.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with State of Kentucky, Highway Department standards.

1.06 PROJECT CONDITIONS

- A. It is recommended that earthwork be done during the warm and dry months. If earthwork is to be done during cold or wet months, the use of DGA in lieu of general soil fill should be considered for structural and pavement areas. Time extensions will not be considered for any delays due to the Contractor choosing to not use DGA in lieu of general soil fill during cold or wet months.
- B. The Geotechnical Exploration Report indicates the presence of existing, undocumented fill. This existing fill material is to be removed per the report recommendations and in accordance with Specification Section 312316 and Section 312323. It is highly recommended that the Contractor excavate test pits prior to preparation of their bids in order to further clarify the extent of the materials.
- C. The Geotechnical Exploration Report indicates the presence of existing fat clay (CH) soils on site. This existing fill material is to be removed per the report recommendations and in accordance with Specification Section 312316 and Section 312323. It is highly recommended that the Contractor excavate test pits prior to preparation of their bids in order to further clarify the extent of the materials.

- D. The soils found on this site are very sensitive to changes in the moisture content and will quickly degrade in such conditions and when subjected to construction traffic. The Contractor should carefully evaluate equipment to be used on the site so as to minimize degradation of the soils. In addition, the Contractor is to include in their bid the stabilization or repair of soils that will be affected by construction activities.
- E. The new vehicular pavement and stone base areas are not designed for construction traffic and should not be used for construction activities unless they are stabilized using #2 crushed stone and geogrid. Stabilization should include any undercutting and material handling, borrow or disposal necessary to maintain the design subgrade elevations after stabilization has been done. Any areas of subgrade, road base or pavement damage are to be repaired.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Excavated from site and free of weeds. Supplement as needed with imported fertile agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0. Topsoil to be amended as needed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify the absence of standing or ponding water.

3.02 PREPARATION

- A. All site grading is unclassified.
- B. Identify required lines, levels, contours, and datum.
- C. Stake and flag locations of known utilities.
- D. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- E. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading. Refer to Specification Section 312319 for additional Dewatering Requirements.
- F. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- G. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- H. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

- E. See Section 312323 for filling procedures.
- F. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- H. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 SOIL REMOVAL and STOCKPILING

- A. Stockpile excavated topsoil on site. No topsoil is to be removed from the site. Topsoil stockpile is to be covered or seeded and mulched to protect the pile from erosion.
- B. Stockpile subsoil that is to be re-used on site; remove remainder from site. Cover stockpile to prevent erosion and saturation of the material.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products and legally dispose of it off-site.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.
- E. Place topsoil to the following compacted thicknesses:
 - 1. Areas to be Seeded with Grass: 6 inches.
 - 2. Areas to be Sodded: 5 inches.
- F. Place topsoil during dry weather.
- G. Remove roots, weeds, rocks, and foreign material while spreading.
- H. Near plants, buildings, and other improvements spread topsoil manually to prevent damage.
- Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- J. Lightly compact placed topsoil.
- K. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.07 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

A. See Section 312323 for compaction density testing.

3.09 CLEANING

- A. Sediment Control/Silt Fencing: Provide fabric silt fencing and other erosion control devices as required and shown on plans to control erosion and allow lawn crew to establish grass uniformly across slope areas.
- B. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- C. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 312316 - EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for footings, slabs-on-grade, paving, site structures, and non-utility excavations in the building pad.
- B. Temporary excavation support and protection systems.

1.02 RELATED REQUIREMENTS

- A. Section 015713 Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 017000 Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring. General requirements for dewatering of excavations and water control.
- C. Section 311000 Site Clearing: Vegetation and existing debris removal.
- D. Section 312200 Grading: Soil removal from surface of site.
- E. Section 312200 Grading: Grading.
- F. Section 312316.13 Trenching: Excavating for utility trenches outside the building to utility main connections.
- G. Section 312319 Dewatering
- H. Section 312323 Fill: Fill materials, backfilling, and compacting.
- I. 312323.13 Flowable Fill

1.03 DEFENITIONS

- A. Finish Grade Elevations: Indicated on Drawings
- B. Zone of Influence: Area beneath a footing or foundation that extends out from the bottom edge of the footing/foundation at a 45-degree angle down to a depth equal to 3 times the footing width.
- C. Fat Clays: Soil types with the classification of CH and a Plasticity Index (PI) above 30%.

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.

1.06 QUALITY ASSURANCE

- A. Temporary Support and Excavation Protection Plan:
 - 1. Bracing and shoring design to meet requirements of OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
- B. Designer Qualifications: For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.07 PROJECT CONDITIONS

A. All excavation is unclassified including bedrock excavation.

B. Verify that survey bench mark and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

- Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Determine the prevailing groundwater level prior to excavation. If the proposed excavation extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by Architect. If the proposed excavation extends more than 1 foot into the prevailing groundwater, control groundwater intrusion with a comprehensive dewatering procedures, or as directed by Geotechnical Engineer. Refer to Specification Section 312319 for additional Dewatering requirements.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 311000 for clearing, grubbing, and removal of existing debris.
- C. See Section 312200 for topsoil removal.
- D. Locate, identify, and protect utilities that remain and protect from damage.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Protect plants, lawns, rock outcroppings, and other features to remain.
- G. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect. Refer to Specification Section 312319 for additional Dewatering requirements.

3.03 TEMPORARY EXCAVATION SUPPORT AND PROTECTION

- A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
 - 1. Excavations in stable rock or in less than 5 feet in depth in ground judged as having no cave-in potential do not require excavation support and protection systems.
 - 2. Depending upon excavation depth, time that excavation is open, soil classification, configuration and slope of excavation sidewalls, design and provide an excavation support and protection system that meets the requirements of 29 CFR 1926, Subpart P:
 - a. Sloping and benching systems.
 - b. Support systems, shield systems, and other protective systems.

3.04 EXCAVATING

- A. Underpin adjacent structures that could be damaged by excavating work. Due to the nature of the on-site soils, excavations will be prone to degradation and collapse and provisions for shoring and stabilization should be included in the bid.
- B. Excavate to accommodate new structures and construction operations.
 - 1. Excavate to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work.
- C. The Geotechnical Report indicates the presence of undocumented fill on site in the area of new foundations. This existing material is to be completely excavated below the proposed new foundation areas within the zone of influence down to insitu soils. The excavation is to be proofrolled and

- brought back up to subgrade elevation in an engineered manner in accordance with the Geotechnical report and Specification Section 312323.
- D. The Geotechnical Report indicates the presence of fat clay (CH) soils on site. This existing material is to be removed to a depth of 2-feet below the subgrade of new foundations and new pavements. he excavation is to be proofrolled and brought back up to subgrade elevation in an engineered manner in accordance with the Geotechnical report and Specification Section 312323.
- E. If a footing/foundation trench or other excavation inside the building footprint is to be left open for more than 48-hours or when a rain event occurs, the excavation is to be over-excavated an additional 4-inches and a lean concrete mud mat or layer of flowable fill should be placed 4-inches thick over the bottom of the excavation. This mud mat can extend no more than 4-inches into the minimum soil cushion between the footing and bedrock.
- F. Fill areas that do not pass proof-roll are to be undercut and/or stabilized as necessary to provide a stable platform for fill placement.
- G. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- H. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- I. Do not interfere with 45 degree bearing splay (zone of influence) of foundations without approval from the Architect and approved specific backfill requirements.
- J. Cut utility trenches wide enough to allow inspection of installed utilities.
- K. Hand trim excavations. Remove loose matter.
- L. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.
- M. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control. Refer to Specification Section 312319 for additional Dewatering requirements.
- N. Determine the prevailing groundwater level prior to excavation. If the proposed excavation extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect. If the proposed excavation extends more than 1 foot into the excavation, control groundwater intrusion with a comprehensive dewatering procedures, or as directed by the Geotechnical Engineer. Refer to Specification Section 312319 for additional Dewatering requirements.
- O. Remove excavated material that is unsuitable for re-use from site.
- P. Stockpile excavated material to be re-used in area designated on site 312200.
- Q. Remove excess excavated material from site.

3.05 REPAIR

 Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.

3.06 FIELD QUALITY CONTROL

- A. See Division 1 for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

3.07 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 312316.13 - TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavation, backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

- A. Section 015713 Temporary Erosion and Sediment Control.
- B. Section 312200 Grading: Site grading.
- C. Section 312316 Excavation: Building and foundation excavating.
- D. Section 312323 Fill: Backfilling at building and foundations.
- E. Section 312323.13 Flowable Fill: Backfill of utilities and excavations in the zone of influence of a foundation, footing or structural element inducing a load to the subgrade materials.
- F. Section 334100 Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Zone of Influence: Area beneath a footing or foundation that extends out from the bottom edge of the footing/foundation at a 45-degree angle down to a depth equal to 3 times the footing width.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- B. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.
- C. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.
- E. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- F. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- H. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill Fill Type Lean Clay (CL): Subsoil excavated on-site.
 - Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Conforming to ASTM D2487 Group Symbol CL.
 - 4. Having no more than 5-percent rock/gravel in the top 24-inches in landscape areas, and no more than 15-percent rock/gravel in any location.
- B. Structural Fill Fill Type DGA: Conforming to State of Kentucky Highway Department standard.
- C. Flowable Fill: A controlled low-strength material made of cement, water, sand, and an air-entraining admixture that it can be excavated by hand or use of a backhoe. See Section 312323.13.
- D. Concrete for Surge Block Fill and structure/pipe encasement: Lean concrete with a compressive strength of 1000 psi.
- E. Pipe Bedding Granular Fill Fill Type #8 crushed limestone: Fine aggregate, conforming to State of Kentucky Highway Department standard.

2.02 ACCESSORIES

A. Geotextile Fabric: Non-biodegradable, non-woven, needle punched, 6-oz/sy(minimum weight).

2.03 SOURCE QUALITY CONTROL

- A. See Division 1 for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. All trenching is unclassified, including trenching in bedrock.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 312200 for additional requirements.
- D. Locate, identify, and protect utilities that remain and protect from damage.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed,

or as directed by the Architect. Refer to Specification Section 312319 for additional Dewatering Requirements.

3.03 TRENCHING

- A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Underpin adjacent structures that could be damaged by trenching work. Due to the nature of the on-site soils, excavations will be prone to degradation and collapse and provisions for shoring and stabilization should be included in the bid.
- D. Do not interfere with 45 degree bearing splay of foundations (Zone of Influence) without approval from the Architect and Structural Engineer and approved specific backfill procedures.
- E. Cut trenches wide enough to allow inspection of installed utilities, but no more than twice the pipe diameter or 12-inches, whichever is greater for the total trench width.
- F. Hand trim excavations. Remove loose matter.
- G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Stockpile excavated material to be re-used in area designated in Section 312200.
- J. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control. Refer to Specification Section 312319 for additional Dewatering Requirements.
- K. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect. Refer to Specification Section 312319 for additional Dewatering Requirements.
- L. If a trench is to be left open for more than 48-hours or when a rain event occurs, the trench is to be excavated an additional 4-inches and a lean concrete mud mat or layer of flowable fill should be placed 4-inches thick over the bottom of the excavation.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with:
 - 1. Flowable Fill in areas located in the zone of influence of any footing or foundation.
 - 2. Structural Fill in areas within the building footprint or under pavements that are not located in the zone of influence.
 - 3. General Fill in landscape areas
- B. Remove loose soil and any debris from the excavation prior to installing the utility and backfill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.

- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Granular/Crushed Stone Fill: Place and compact materials in equal continuous layers not exceeding 6 inches loose depth when using heavy compaction equipment (sheepsfoot rollers, smooth drums, etc.) and not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches loose depth when using heavy compaction equipment (sheepsfoot rollers, smooth drums, etc.) and not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- G. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 98 percent of maximum dry density.
- I. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under slabs-on-grade and similar construction: 98 percent of maximum dry density.
 - 2. At paving: 95 percent of maximum dry density.
 - 3. At landscape locations: 85 percent of maximum dry density.
- J. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Utility Piping, Conduits, and Duct Bank:
 - 1. Bedding: Use Fill Type Pipe bedding granular fill for the initial 4-inch thick utility setting/leveling bed.
 - 2. If pipe is larger than 12-inches or if there are multiple pipes of any size utilizing the same trench (hoizontally or vertically), then the leveling bed and pipe bedding backfill is to be wrapped in filter fabric.
 - 3. Cover with pipe bedding granular fill to 6-inches above the utility and finish with general fill in non-structural locations, and structural fill in building and pavement locations. If the utility is located within the zone of influence of a foundation, the trench is to be backfilled with flowable fill from the top of the initial utility setting/leveling bed and encompassing the utility until it is at least 1-foot above the zone of influence. When using flowable fill as a utility trench backfill, care should be taken to prevent the utility from floating by using deadman anchors or another anchoring system.
 - 4. Fill up to subgrade elevation.
 - 5. Compact to 98 percent of maximum dry density.
 - 6. Compact in maximum 6 inch loose lifts to 98 percent of maximum dry density.
- B. At Sanitary Pipes:
 - 1. Bedding: Use Fill Type Pipe bedding granular fill for the initial utility setting/leveling bed.
 - 2. If pipe is larger than 12-inches or if there are multiple pipes of any size utilizing the same trench (hoizontally or vertically), then the leveling bed and pipe bedding backfill is to be wrapped in filter fabric.
 - 3. Cover with pipe bedding granular fill to 6-inches above the utility pipe and finish with general fill in non-structural locations, and structural fill in building and pavement locations. If the sanitary pipe is located within the zone of influence of a foundation, the trench is to be backfilled with flowable fill from the top of the 6-inch cover until it is at least 1-foot above the zone of influence. Felt paper (15 lb) is to be installed around any sanitary standpipes as

necessary to prevent the pipe from being in direct contact with the flowable fill. When using flowable fill as a utility trench backfill, care should be taken to prevent the utility from floating by using deadman anchors or another anchoring system.

- 4. Fill up to subgrade elevation.
- 5. Compact to 98 percent of maximum dry density.
- 6. Compact in maximum 6 inch lifts to 98 percent of maximum dry density.
- C. Over Subdrainage Piping at Foundation Perimeter:
 - 1. Drainage fill and geotextile: Section 334100.
 - 2. Cover drainage fill with general fill.
 - 3. Compact to 95 percent of maximum dry density.
- D. At French Drains:
 - 1. Use Graded Granular Fill.
 - 2. Compact to 95 percent of maximum dry density.

3.07 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

- A. See Division 1 for general requirements for field inspection and testing.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests: One (1) test for each 150 feet or less of trench length, but no fewer than two (2) tests..

3.09 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 312319 - DEWATERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering of site during construction.

1.02 RELATED SECTIONS

- A. Section 312316 Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- B. Section 312323 Fill: Filter aggregate, up to subgrade elevation.
- C. Section 312316.13 Trenching: Excavating and backfilling for site subdrainage systems.
- D. Section 334600 Subdrainage

1.03 REFERENCES

A. ASTM D 2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2003.

1.04 PROJECT CONDITIONS

- A. The Contractor is to provide any temporary piping required to reroute downspout and roof drains away from the work areas until the permanent drainage system is installed and in working order.
- B. Damage or destabilization/degradation of the on-site soils due to failure to dewater or otherwise prepare the site will be repaired at the Contractors expense.

1.05 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance:
 - 1. Design, furnish, install, test, operate, monitor and maintain dewatering system of sufficient scope, size and capacity to control surface and ground water flow into excavations and permit construction to proceed on dry stable subgrades.
 - 2. Prevent water from ponding inside foundation walls, including after the floor slabs have been installed, and causing the foundation soils to become saturated.

PART 2 - NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades and from flooding the Project site and surrounding areas.
- B. Reroute surface water away from excavated areas. Do not allow water to accumulate in excavations or on footings that have already been installed but not backfilled. Do not use utility, foundation or other trenches as temporary drainage ditches unless specifically designed for only that purpose.
- C. Prevent water from ponding inside the foundation walls, within the building footprint and in pavement areas.
- D. The Contractor is to provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations and control the groundwater to a level at least 3'-0" below the lowest point of the excavation.
- E. Do not use open-sump pumping that leads to loss of fines, soil piping, subgrade softening and slope instability.

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- F. Dispose of water removed by dewatering in a manner that avoids endangering public health, property and portions of work under construction or completed. Avoid creating an inconvenience to others, and maintain sedimentation controls as required by authorities having jurisdiction.
- G. All dewatering discharge is to be routed to a sediment pond or sediment bags so that the sediment can settle prior to the discharge water leaving the site or entering any waterway or storm sewer.

3.02 FIELD QUALITY CONTROL

- A. Dewatering systems are to be inspected at least weekly and any and all repairs or refinements performed to maintain a fully operational system that achieves the intended purpose.
- B. Standby equipment is to be maintained on site so that it can be immediately installed if failure of primary equipment occurs.

3.03 PROTECTION

- A. Protect pipe and dewatering system from other construction activities.
- B. Remove dewatering system at the completion of construction or when determined by the Architect that it is no longer needed. Any holes in interior slabs and voids under the slabs are to be repaired using lean concrete for the voids and an non-shrink concrete repair grout for the slabs.

END OF SECTION

DEWATERING 312319 - 2

SECTION 312323 - FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for footings, paving, and non-utility excavations located within the building and future building footprints.
- B. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

- A. Section 015713 Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 310519 Geosynthetics for Earthwork.
- C. Section 312200 Grading: Removal and handling of soil to be re-used.
- D. Section 312200 Grading: Site grading.
- E. Section 312316 Excavation: Removal and handling of soil to be re-used.
- F. Section 312316.13 Trenching: Excavating and backfilling for utility trenches outside the building to utility main connections.
- G. Section 312323.13 Flowable Fill
- H. Section 334100 Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Zone of Influence: Area beneath a footing or foundation that extends out from the bottom edge of the footing/foundation at a 45-degree angle down to a depth equal to 3 times the footing width.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- B. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.
- C. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.
- E. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- F. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- H. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.05 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.
- D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- General Fill Fill Type Lean Clay: Subsoil excavated on-site and imported as necessary for new work.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Conforming to ASTM D2487 Group Symbol CL.
 - 4. Having no more than 5-percent rock/gravel in the top 24-inches in landscape areas, and no more than 15-percent rock/gravel in any location.
- B. Structural Fill Fill Type DGA: Conforming to State of Kentucky Highway Department standard.
- C. Flowable Fill: A controlled low-strength material made of cement, water, sand, and an air-entraining admixture that it can be excavated by hand or use of a backhoe. See Section 312323.13.
- D. Topsoil: See Section 312200.

2.02 ACCESSORIES

A. Geotextile Fabric: Water pervious type, black polypropylene, non-biodegradable, non-woven, needlepunched, 6 oz minimum weight.

2.03 SOURCE QUALITY CONTROL

- See Section 014000 Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- All fill material is unclassified.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.
- C. Identify required lines, levels, contours, and datum locations.
- D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

- E. Verify structural ability of unsupported walls to support imposed loads by the fill.
- F. Verify that all previously placed fill material has been completely removed below the planned bearing elevation for all new foundation extending outside the zone of influence of the footings.
- G. Verify that fat clay (CH) material has been removed under all floor slabs, new foundations and pavement areas so that no fat clay is located within 24-inches of the top of proposed subgrade for each item.
- H. Proof roll all areas to receive fill prior to placing fill as required in the geotechnical report. Proof rolls should only be done when the soils are are near optimum moisture content. Any areas that do not pass proof roll are to be stabilized and approved in accordance with the Geotechnical Report. Any suitable soils removed as part of the stabilization process due to moisture content issues are to be moisture conditioned and used as fill in other locations.
- I. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill or as outlined per over-excavation below.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Soils are not to be "over-compacted" or worked in a manner that will cause them to break down and lose strength.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular/Crushed Stone Fill: Place and compact materials in equal continuous layers not exceeding 6 inches loose depth when using heavy compaction equipment (sheepsfoot rollers, smooth drums, etc.) and not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches loose depth when using heavy compaction equipment (sheepsfoot rollers, smooth drums, etc.), and layers not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- H. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
 - Load-bearing foundation surfaces and floor slab areas: Use structural fill, compacted to 98 percent of maximum dry density, to slab subgrade elevation in areas outside of the zone of influence of any footings or foundations. All excavations in the zone of influence of any footings or foundations are to be backfilled with flowable fill. If the backfill of the over-excavated areas encroaches into the minimum of 12-inches of soil cushion between the bottom of the footing and the top of bedrock, the Architect and Structural Engineer are to be notified immediately to determine if an alternate backfill method is necessary.

- 2. Drives and vehicular pavement areas: Use DGA over a layer of Tensar BX1200 geogrid up to the required bottom of pavement crushed stone base elevation.
- 3. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- J. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 98 percent of maximum dry density.
 - 2. At paving/paver areas: 95 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.
- L. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control. Refer to Specification Section 312319 for additional Dewatering requirements.

3.04 FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Building Pad Mass Fill:
 - 1. Use General Fill or Structural Fill. Fill is to be uniform and contractor shall not mix materials dueing filling operations..
 - 2. Fill up to subgrade elevations.
 - 3. Maximum depth per lift: 6 inches, compacted.
 - 4. Compact to minimum 98 percent of maximum dry density.
- C. Excavations within the zone of influence (ZOI) of any footing or foundation:
 - 1. Use Flowable Fill. See MEP and Structural Engineer drawings and specifications for utility excavation backfill requirements inside the building footprint.
- D. At Foundation Walls and Footings where excavation was done after the building pad was constructed and within the Zone of Influence:
 - 1. Use flowable fill where excavation was done within the Zone of Influence. Flowable fill is to extend to a minimum of 1-foot above the Zone of Influence.
 - 2. Use structural fill where excavation was done outside of the Zone of Influence.
- E. Against Foundation Walls and Footings where foundation drainage is not required:
 - 1. Use structural fill as backfill against the foundations/stem walls above the top of footing inside the building footprint, and general fill outside of the building footprint above the top of footing. Compact per above requirements.
 - 2. Fill up to subgrade elevation.
 - 3. Do not backfill against unsupported foundation walls.
 - 4. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- F. At Foundation Walls and Footings where excavation was done within the Zone of Influence:
 - 1. Use flowable fill from the bottom of the excavation to a minimum elevation of 1-foot above the ZOI for all non-utility excavations. Maintain the minimum soil cushion thickness between the bottom of the flowable fill and bedrock where located under and within 1-foot of the edge of any footing.
- G. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
 - 1. Drainage fill and geotextile: Section 310519.
 - 2. Wrap all granular fill with geotextile fabric to completely separate soils and other materials from the granular materials.
 - 3. Cover drainage fill with general fill.
 - 4. Compact to 95 percent of maximum dry density.

H. At Lawn Areas:

- 1. Use general fill.
- 2. Compact to 85 percent of maximum dry density.
- 3. See Section 312200 for topsoil placement.

I. At French Drains:

- 1. Use granular fill.
- 2. Wrap all granular fill with geotextile fabric to completely separate soils and other materials from the granular materials.
- 3. Fill up to 8 inches below finish grade.
- 4. Compact to 95 percent of maximum dry density.

J. Under Pavements:

- 1. Use general fill or structural fill.
- 2. Fill up to subgrade elevation.
- 3. Maximum compacted depth of each lift: Fill according to Part 3.03 Items F and G as listed above.
- 4. Compact to 95 percent of maximum dry density.

K. Landscape Area Backfill:

- 1. Do not backfill landscape planting beds, landscape islands, or tree pits with construction or other debris. These areas are to be free of debris and particles 1/2 inch or larger in size, down to a depth of 24 inches minimum.
- 2. Gravel, rock or concrete particles of no more than 1/2 inch in any dimension, shall constitute no more than 10% of the backfill content of planting beds, planting islands, and tree pits.

3.05 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1/2 inch from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch from required elevations.

3.06 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: One (1) test for every 2000 sq. ft. or less of paved area or building slab per lift, but in no case fewer than two (2) tests per lift.
- F. The Contractor should anticipate and allow for testing time of encountered and imported materials. Some testing can take three to four business days.
- G. Proof roll compacted fill at surfaces that will be under slabs-on-grade and paving.

3.07 CLEANING

- A. See Section 017419 Construction Waste Management and Disposal, for additional requirements.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

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SECTION 312323.13 - FLOWABLE FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flowable Fill or Controlled Low Strength Materials (CLSM)
- B. Backfill for site utilities within the zone-of-influence of any footing/foundation.

1.02 RELATED REQUIREMENTS

- A. Section 312316.13 Trenching: Excavation and backfilling for foundations and utilities outside the building footprint.
- B. Section 312323 Fill: Filling and Compaction.

1.03 REFERENCE STANDARDS

- A. ACI 301 Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.
- B. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- C. ACI 305R Hot Weather Concreting; American Concrete Institute International; 2010.
- D. ACI 306R Cold Weather Concreting; American Concrete Institute International; 2010.
- E. ASTM C33/C33M Standard Specification for Concrete Aggregates; 2011a.
- F. ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2012.
- G. ASTM C150/C150M Standard Specification for Portland Cement; 2012.
- H. ASTM C173/C173M Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2010b.
- I. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- J. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete; 2011.
- K. ASTM C685/C685M Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2011.
- L. ASTM D4832 Preparation and Testing of Controlled Low Strength Material Test Cylinders
- M. ASTM D5971 Sampling Freshly Mixed Controlled Low Strength Material
- N. ASTM D6103 Flow Consistency of Controlled Low Strength Material
- O. ASTM D6023 Unit Weight, Yield, Cement Content and Air Content (Gravimetric) of Controlled Low Strength Material

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on mix materials and admixtures.
- C. Design Data: Mix design and test results showing that the mix design meets the mix and performance requirements.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Cement: ASTM C150/C150M Air Entraining Type IA portland type, grey color.
- C. Fine Mix Aggregates: ASTM C33.
- D. Fly Ash: ASTM C 618, Class F Optional for Non-Excavatable flowable fill.
- E. Water: Clean, and not detrimental to concrete.
- F. Air Entrainment Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494/C494M, Type A Water Reducing.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.02 ACCESSORIES

- A. Utility Anchors: Manufactured anchorsSurface Retarder:
 - 1. Manufactured anchoring system to prevent vertical and horizontal movement of the utility during installation and curing of Flowable Fill/CLSM.

2.03 FLOWABLE FILL/CLSM MIX DESIGN

- A. The Flowable Fill/CLSM material is to be a self-leveling and self-compacting, cementitious material with low compressive strength (see below).
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. If flowable fill is to be pumped, a modified mixture shall be submitted along with test results that indicate that the mix will meet the strength restrictions. In addition, the supplier is to ensure that the air content at the point of discharge from the pump meets the below requirements.
- D. Excavatable Flowable Fill Properties (not-pumped):
 - 1. Compressive Strength, when tested in accordance with ASTM D4832 at 28 days: 30 to 80 psi maximum. Strength shall not exceed 130 psi at 180-days.
 - 2. Fly Ash Content: None
 - 3. Cement Content: 50 to 100 lb per cubic yard.
 - 4. Water: Content to provide self-leveling mix with flowability per below and without excess
 - 5. Total Air Content: 20-30 percent, determined in accordance with ASTM D6023.
 - 6. Flowability: 6 to 8 inches in accordance with ASTM D6103.
 - 7. Unit Weight (wet): 90-115 pcf
 - 8. Aggregate Size: Concrete Sand

2.04 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. Do not add water to the mix once the truck has left the concrete plant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify trench subgrade is acceptable and ready to support fill and future loads.

- B. Verify gradients and elevations of base are correct.
- C. Verify that utilities have been properly anchored to eliminate vertical and horizontal movement.

3.02 PREPARATION

- A. Wrap utilities with protective felt paper or other protective wrap as approved by the governing body for the utility.
- B. Notify Testing Agent minimum 24 hours prior to filling operations.

3.03 FORMING

A. Place and secure forms as necessary at the ends of each pour.

3.04 COLD AND HOT WEATHER INSTALLATION

- A. Follow recommendations of ACI 305R when installing during hot weather.
- B. Follow recommendations of ACI 306R when installing during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- D. Protect from freezing for a minimum of 36-hours after placement.

3.05 PLACING FLOWABLE FILL/CLSM

- Place fill in accordance with ACI 304R.
- B. Place fill material continuously over the full width of the trench/excavation.

3.06 TOLERANCES

- A. The contractor should anticipate a 1/8-inch per foot of depth shrinkage of the Flowable Fill/CLSM material during the initial 7-day curing period.
- B. Maximum Variation From True Position Post-Cure: Plus 1/4 inch (no minus).

3.07 FIELD QUALITY CONTROL

- A. The Owner will employ an independent testing agency to perform field quality control tests, as specified in Division 1 Sections.
 - 1. Provide free access to Flowable Fill/CLSM operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of Flowable Fill/CLSM to inspection and testing firm for review prior to commencement of installation operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM D4832. For each test, mold and cure five Flowable Fill/CLSM test cylinders. Obtain test samples for every truck delivered.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as material it represents.
 - 2. Perform one flowability test and one air content test for each set of test cylinders taken.
 - 3. Perform compression tests at 7-days, 14-days, 28-days, 56-days and 180-days
- C. Maintain records of placed Flowable Fill/CLSM items. Record date, pour time, batch time, location of pour, quantity, air temperature, and test samples taken. All test reports are to by typed.

D. Any tests or time limits that do not meet the specified requirements are to be reported to the Contractor and that material shall be considered unacceptable. Any material placed that is deemed unacceptable shall be removed and replaced with acceptable material.

3.08 PROTECTION

- A. Immediately after placement, protect from premature drying, excessive hot or cold temperatures, and mechanical injury for a minimum of 36-hours.
- B. Do not subject the fill material to foundation or other loads that may exceed the material strength. **END OF SECTION**

SECTION 312513 - PERMANENT EROSION CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Erosion blankets and netting.
- B. Slope protection
- C. protection (non-rip rap)

1.02 RELATED SECTIONS

- A. Section 015713 Temporary Erosion Controls
- B. Section 312200 Grading
- C. Section 311000 Site Clearing.
- D. Section 312316 Excavation.
- E. Section 312323 Fill: Filling and compaction.
- F. Section 313700 Riprap
- G. Section 329219 Seeding: Finish ground cover.
- H. Section 329223 Sodding: Finish ground cover.

1.03 REFERENCES

- A. Kentucky Erosion Prevention and Sediment Control Field Guide by Kentucky Division of Conservation. Refer to these guidelines for construction and maintenance of erosion control items.
- B. Kentucky Division of Water (www.water.ky.gov)

1.04 SUBMITTALS

A. Erosion Control Material Data: Include manufacturer, product and design calculations for each product used.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with State of Kentucky, Highway Department standards.

1.06 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.
- B. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from installation equipment and vehicular traffic.

PART 2 PRODUCTS

2.01 MATERIALS

- A. High Velocity Erosion-Control Blankets: Coconut-fiber mat enclosed in a double-net, UV stabilized polypropylene mesh with a minimum 36-month design life. Include manufacturer's recommended biodegradable stakes, 6 inches (150 mm) long. Acceptable products are:
 - 1. Curlex III by American Excelsior Company
 - 2. C125 by North American Green
 - 3. ECC-2 by East Coast Erosion Blankets

- B. Long-Term Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a double-net, photo-degradable woven mesh with a minimum 1-year design life. Include manufacturer's recommended biodegradable stakes, 6 inches long. Acceptable products are:
 - 1. Curlex II by American Excelsior Company
 - 2. S150 by North American Green
 - 3. ECS-2 and ECX-2 by East Coast Erosion Blankets
- C. Short-Term Erosion-Control Blankets: Biodegradable twisted jute or spun-coir mesh in a single-net product with straw or coconut-fiber fill. Include manufacturer's recommended steel wire staples, 6 inches long. Acceptable products are:
 - 1. Curlex I by American Excelsior Company
 - 2. S75 by North American Green
 - 3. ECS-1 by East Coast Erosion Blankets
- D. Other Materials: See Section 312323.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that finish grading and intended elevations for the Work are as indicated and that all debris and rock fragments larger than 1/2-inch have been removed from the area to be covered.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify and mark areas to receive erosion controls.

3.03 INSTALLATION

- A. Protect areas to be seeded as follows:
 - 1. Ditches and drainage swales are to receive high-velocity erosion-control blankets.
 - 2. Slopes 4:1 (H:V) or greater are to receive long-term erosion-control blankets.
 - 3. Slopes between 4:1 and 6:1 are to receive short-term erosion-control blankets.
 - 4. If drawings indicate installation of flexible concrete erosion controls, the flexible concrete erosion controls are to be installed over the erosion control blankets and not as a substitute.
- B. Roll out erosion controls beginning at the bottom of the slope or the lowest end of the ditch line.
- C. Overlap ends of the controls a minimum of 24-inches or per the manufacturers recommendation, whichever is larger.
- D. Overlap the edges of the controls a minimum of 12-inches or per the manufacturers recommendation, whichever is larger.
- E. Install biodegradable anchors per the manufacturers recommendation. If erosion controls begin to pull up, slide or otherwise come loose, install additional anchors as needed for proper installation.
- F. Sod can be used for all slopes identified above (not drainage swales or ditches) as a substitute for the listed erosion controls. Sod is to be laid perpendicular to the slope and staked to prevent slipping.

3.04 CLEANING AND PROTECTION

A. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 313700 - RIPRAP

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Riprap.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Riprap: Provide in accordance with State of Kentucky Highways standards.
- B. Geotextile Fabric: Non-biodegradable polypropylene, non-woven, and needle punched with 6oz minimum weight.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Spray subgrade with weed control
- B. Place geotextile fabric over substrate, lap edges and ends.
- C. Place riprap at headwall outlets as indicated.
- D. Place Riprap into position. Knead or ram riprap to conform to contours as identified on the plans.
- E. Installed Thickness: 12 inch average.
- F. Place rock evenly and carefully minimize voids, do not tear fabric, place riprap in one consistent operation to preclude disturbance or displacement of substrate.

END OF SECTION

RIPRAP 313700 - 1

SECTION 321123 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 312200 Grading: Preparation of site for base course.
- B. Section 312323 Fill: Compacted fill under base course.
- C. Section 321313 Concrete Paving: Finish concrete surface course.
- D. Section 334913 Storm Drainage Manholes, Frames and Covers: Manholes and frames.

1.03 REFERENCE STANDARDS

- A. AASHTO M 147 Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; 1965 (2004).
- B. AASHTO T 180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- C. ASTM C136/C136M Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- D. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.
- E. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.
- F. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- H. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- I. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Aggregate Storage, General:

- 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
- 2. Prevent contamination.
- 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Coarse Aggregate Type #2 Stone: Coarse aggregate, conforming to State of Kentucky Highway Department standard.
- B. Blended Aggregate Type DGA: Pug DGA conforming to State of Kentucky Highway Department standard.
- C. Herbicide: In accordance with State of Kentucky Highway Department Standards.

2.02 SOURCE QUALITY CONTROL

- A. See Division 1 for Quality Requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.
- C. Proof-roll areas to receive aggregate base course material and have proof-roll approved by the soils testing agent.
- D. Due to the type of soils encountered on the site, proof-rolling during wet periods or when the existing soils are above optimum moisture content will not be acceptable. All proof-rolling will need to be done during dry conditions.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Under Portland Cement Concrete Paving:
 - 1. Place Blended Aggregate Type DGA to a total compacted thickness as identified on the drawings.
 - 2. Compact to 95 percent of maximum dry density.
- B. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- G. Apply herbicide to finished surface.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.

3.05 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: One (1) test for every 2000 sq. ft. or less of paved area per lift, but in no case fewer than two (2) tests per lift.
- F. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.

3.06 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 321313 - CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks and integral curbs.

1.02 RELATED REQUIREMENTS

- A. Section 031000 Concrete Forming and Accessories.
- B. Section 312200 Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
- C. Section 312323 Fill: Compacted subbase for paving.
- D. Section 321123 Aggregate Base Courses: Blended Aggregate DGA base course.
- E. Section 321373 Joint Sealers: Sealant for joints.
- F. Section 321613 Concrete Curb and Gutters

1.03 REFERENCE STANDARDS

- A. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 301 Specifications for Structural Concrete; 2010 (Errata 2012).
- C. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- D. ACI 305R Hot Weather Concreting; 2010.
- E. ACI 306R Cold Weather Concreting; 2010.
- F. ASTM A36 Steel plate for plate dowel systems.
- G. ASTM A185/A185M Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- H. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- I. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- J. ASTM B633 Type II Electroplated zinc for plat dowel systems
- K. ASTM C33/C33M Standard Specification for Concrete Aggregates; 2013.
- ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- M. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete; 2015.
- N. ASTM C150/C150M Standard Specification for Portland Cement; 2015.
- O. ASTM C173/C173M Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- P. ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- Q. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

- R. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete; 2013.
- S. ASTM C685/C685M Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- T. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- U. ASTM D1752 Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2013).

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, curing compound, and fiber reinforcement.
- C. Installer qualifications using Macro Fiber reinforcement in finished, exterior concrete pavement.
- D. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Form Materials: As specified in Section 031000, conform to ACI 301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
 - 1. Thickness: 3/8 inch.

2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 80 (80,000 psi) yield strength; deformed billet steel bars; unfinished.
- B. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.
- C. Plate Dowels: Light and Medium Duty Concrete ASTM A36 steel plates with electroplated zinc coating meeting ASTM B633 Type II. Plate sizes and spacing to meet specified concrete thickness.

2.03 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: Provide in accordance with State of Kentucky Highways standards.
- C. Cement: ASTM C150/C150M, Normal Type I Portland cement, gray color.
- D. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- E. Water: Clean, and not detrimental to concrete.
- F. Fiber Reinforcement: Shrinkage crack control, micro synthetic, fibrilated, polypropylene fibers shown to have long-term resistance to deterioration when in contact with alkalis and moisture; 3/4 to 1 inch length and designed to reduce shrinkage cracking of concrete.
 - 1. Acceptable Products:
 - a. PSI FIBERSTRAND F by Euclid Chemical
 - b. Procon F-E by Nycon Corporation
 - c. Fibermesh 300 by Propex Operating Company

d. Econo-Net by Forta Corporation

- G. Air-Entraining Admixtures: ASTM C260/C260M.
- H. Chemical Admixtures: ASTM C494/C494M, Type A Water Reducing.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.04 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 1, Class A.
- B. Curing Compound:
 - 1. Sonneborn's Sonosil
 - 2. L&M's L&M Cure
 - 3. Dayton Superior's Day Chem Sil-Cure (J-13)
- C. Joint Sealer: Type as specified in Section 321373.

2.05 CONCRETE MIX DESIGN

- Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- B. Micro Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions. Fiber is to be added at the plant after all other materials have been added, and have a minimum mix time of 5-minutes..
- C. Concrete Properties:
 - 1. Compressive strength (prior to fiber), when tested in accordance with ASTM C39/C39M at 28 days; 4500 psi. Testing of the concrete mix prior to adding fiber and again after fiber has been added is required to set the compressive strength requirement for fiber reinforced concrete. This should be done for the first pour of each mix design and the results used to confirm future pours.
 - 2. Cement Content: Minimum 600 lb per cubic yard.
 - 3. Water-Cement Ratio: Maximum 0.44 percent by weight.
 - 4. Total Air Content: 6 percent +/- 1%, determined in accordance with ASTM C 173/C 173M.
 - 5. Maximum Slump: 4 inches using base design, 5 inches when using fiber and mid-range water reducer, 6 inches when using a mid-range water reducer, +/- 1-inch.
 - 6. Maximum Aggregate Size: 1 inch.

2.06 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. Do not add water to the mix once the truck has left the concrete plant.

PART 3 EXECUTION

3.01 EXAMINATION

- Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

A. See Section 321123 for construction of base course for work of this Section.

3.03 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated and per the manufacturers recommendations.
- B. Provide doweled joints at all isolation joints with one end of dowel set in capped sleeve to allow longitudinal movement.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Do not add water to concrete.
- C. Ensure reinforcement, inserts, embedded parts, formed joints and forming materials are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- E. Place concrete to indicated pattern.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch wide isolation joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.
- C. Provide tooled contraction control joints:
 - 1. In pattern shown on drawings.

3.09 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius. Remove tooling marks to prevent a picture frame effect.
- C. Remove "slop" created by the concrete finishing from all joints and edges.

D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.10 JOINT SEALING

A. See Section 321373 for joint sealer requirements.

3.11 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.12 FIELD QUALITY CONTROL

- A. Allow the independent testing agency to perform field quality control tests, as specified in Division 1.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - Test fiber reinforced concrete prior to the addition of fiber and again after fiber has been added to set the baseline for the fiber reinforced compressive strength, slump and air content. This is to be done for the first pour of each mix design, and the results used for later pour strength requirements.
 - 2. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 3. Perform one slump test and one air content test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken. All test reports are to by typed.
- D. Any tests or time limits that do not meet the specified requirements are to be reported to the Contractor and that concrete shall be considered unacceptable.

3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 2 days minimum after finishing.
- C. Do not permit vehicular traffic over pavement until 75 percent design strength of concrete has been achieved.
- D. All pavements that are soiled or otherwise dirty are to be pressure washed and rinsed upon completion of the construction and landscaping work.

END OF SECTION

SECTION 321373 - PAVEMENT JOINT SEALANTS

PART 1-GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and asphalt pavement.
 - 3. Joints between cement concrete or asphalt pavement and adjacent structures.
 - 4. Joints between concrete banding and detectable warning pavers.
- B. Related Sections include the following:
 - 1. Section 321313 Concrete Paving: constructing joints in concrete pavement.
 - 2. Section 321613 Concrete Curbs and Gutters

1.03 SUBMITTALS

- A. Product Data: For each joint sealant product indicated.
- B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- C. Qualification Data: For Installer.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- B. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use ASTM C 1087 or manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the Notice to Proceed with the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 PROJECT CONDITIONS

- A. All expansion, isolation and cold joints, including those in concrete curbs, are to receive joint sealant.
- B. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
 - 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C), whichever is higher.
 - 3. When joint substrates are wet or covered with frost.
 - 4. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 - 5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2-PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03 COLD-APPLIED JOINT SEALANTS

- A. Type S, Grade NS, Class 25 Polyurethane Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag urethane sealant complying with ASTM C920
 - 1. Sikaflex-1a
 - 2. Bostik Seal 'N' Flex FC
 - 3. Tremco Vulkem 116

2.04 JOINT SEALANT BACKER MATERIALS

- A. General: Provide joint sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.
- B. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.05 PRIMERS

A. Primers: Product recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer, based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.04 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.
- B. Apply clean, white, silica sand dusting to the finished tooled surface of the joint sealant to help prevent tracking of the material.

END OF SECTION

SECTION 321613 - CONCRETE CURBS AND GUTTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

Concrete header curbs and curbs.

1.02 RELATED REQUIREMENTS

- A. Section 312200 Grading: Preparation of site for paving and base.
- B. Section 312323 Fill: Compacted subbase for paving.
- C. Section 321123 Aggregate Base Courses: base course.
- D. Section 321373 Joint Sealers: Sealant for joints.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 301 Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- C. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- D. ACI 305R Hot Weather Concreting; American Concrete Institute International; 1999.
- E. ACI 306R Cold Weather Concreting; American Concrete Institute International; 1988 (Reapproved 2002).
- F. ASTM A 615/A 615M Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- G. ASTM C 33 Standard Specification for Concrete Aggregates; 2007.
- H. ASTM C 39/C 39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2005.
- I. ASTM C 94/C 94M Standard Specification for Ready-Mixed Concrete; 2007.
- J. ASTM C 150 Standard Specification for Portland Cement; 2007.
- K. ASTM C 173/C 173M Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2008a.
- L. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete; 2006.
- M. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2007.
- N. ASTM C 494/C 494M Standard Specification for Chemical Admixtures for Concrete; 2008a.
- O. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2008a.
- P. ASTM C 685/C 685M Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2007.
- Q. ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2008).

R. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2008).

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, curing compound, and fiber reinforcement.
- C. Installer qualifications using Macro Fiber reinforcement in finished, exterior concrete.
- D. Design Data: Indicate curb/gutter thickness, designed concrete strength, reinforcement, and typical details. Separate mix designs are required for conventionally formed concrete and machine placed or slip-formed concrete.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Form Materials: Conform to ACI 301 and as follows.
- B. Steel forms with self-aligning joints designed to withstand the lateral and vertical loads associated with the concrete placement. Form sections are to be a minimum of 10-feet in length for runs that are 10-feet or longer in length.
- C. Joint Filler: Preformed; non-extruding bituminous type (ASTM D 1751) or sponge rubber or cork (ASTM D 1752).
 - 1. Thickness: 3/8 inch.

2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.
- B. Steel Welded Wire Reinforcement: Plain type, ASTM A 185/A 185M; in flat sheets; unfinished.
- C. Dowels: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.

2.03 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: Provide in accordance with State of Kentucky Highways standards.
- C. Cement: ASTM C 150 Air Entraining Type IA portland type, grey color.
- D. Fine and Coarse Mix Aggregates: ASTM C 33.
- E. Fly Ash: ASTM C 618, Class F Optional for mixes used for slip forming of curb and gutter, or slip forming of concrete pavements. Fly ash is not to be used in concrete that is not slip formed or extruded..
- F. Water: Clean, and not detrimental to concrete.
- G. Fiber Reinforcement: Structural, macro synthetic, fibrilated, polypropylene fibers shown to have long-term resistance to deterioration when in contact with alkalis and moisture; 1.5 to 2 inch length and manufactured to provide post-cure concrete strength and increase freeze/thaw resistance.
 - 1. Acceptable Products:
 - a. TUF-STRAND SF by Euclid Chemical
 - b. Nycon-XL200 by Nycon Corporation
 - c. Fibermesh 650 by Propex Operating Company
 - d. Forta-Ferro by Forta Corporation

- H. Air Entrainment Admixture: ASTM C 260.
- I. Chemical Admixtures: ASTM C 494/C 494M, Type A Water Reducing.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.04 ACCESSORIES

- A. Curing Compound: ASTM C 309, Type 1, Class A.
- B. Joint Sealer: Type as specified in Section 321373.

2.05 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. Macro Fiber Reinforcement: Add to mix at rate of 7 pounds per cubic yard, or as recommended by manufacturer for specific project conditions. Fiber is to be added at the plant after all other materials have been added, and have a minimum mix time of 5-minutes. Fiber reinforcement is only to be used when slip forming of concrete is performed.

D. Concrete Properties:

- Compressive Strength (prior to adding fiber), when tested in accordance with ASTM C 39/C 39M at 28 days: 4500 psi. Testing of the concrete mix prior to adding fiber and again after fiber has been added is required to set the compressive strength requirement for fiber reinforced concrete. This should be done for the first pour of each mix design and the results used to confirm future pours.
- 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
- 3. Cement Content: Minimum 639 lb per cubic yard.
- 4. Water-Cement Ratio: Maximum 0.44 percent by weight.
- 5. Total Air Content: 6 percent +/- 1%, determined in accordance with ASTM C 173/C 173M.
- 6. Maximum Slump: 4 inches using base design, 5 inches when using fiber and mid-range water reducer, 6 inches when using a mid-range water reducer, +/- 1-inch.
- 7. Maximum Aggregate Size: 1 inch.

2.06 MIXING

- A. Transit Mixers: Comply with ASTM C 94/C 94M.
- B. Do not add water to the mix once the truck has left the concrete plant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

A. See Section 321123 for construction of base course for work of this Section.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of storm structure frames with oil to prevent bond with concrete curb/gutter.

C. Notify Architect minimum 24 hours prior to commencement of concreting operations. Architect is to review and approve sample pours prior to installation of permanent concrete.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.
- D. Slip forming can be used for curb and gutter combinations. The slip form machine shall be self-propelled and designed to place, consolidate and finish the concrete in one pass, and be adjustable to install gutter lines that slope away from the curb where required.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Use fiber reinforcement for all concrete.
- C. Provide doweled joints as indicated with one end of dowel set in capped sleeve to allow longitudinal movement.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Do not place concrete when base surface is wet.
- C. Concrete can be placed using the slip form technique. If slip forming is used, fiber-reinforced concrete shall be used.
- D. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- E. Place concrete continuously over the full length of the run and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- F. Place expansion joints at the beginning and ending of each pour.
- G. Place expansion joints at the beginning and ending of each pour. Place control joints concrete to indicated pattern.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch wide expansion joints at 40 foot intervals and to separate curb and gutter from adjacent sidewalks, vertical surfaces and other components.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.

- C. Provide sawcut contraction control joints every 8-feet. Where the curb is adjacent to a sidewalk, install contraction joints that align with the sidewalk joints with spacing between 8-feet and 10-feet.
- D. Provide tooled contraction joints between curbs/gutters and adjacent traffic duty pavements.
- E. At 90-degree curb corners, the contraction joint is to be cut parallel to the traffic lane. Diagonal cuts at 90-degree corners are not acceptable.

3.09 FINISHING

- A. Curbs and Gutters: Uniform float finish and round edges. Correct all honeycombed areas by filling with mortar. Do not plaster. Finish the top and face while the concrete is plastic by wetting and rubbing with a carborundum brick. Finish the face of header curbs to 4-inches below the finished ground line. Provide uniform texture and color.
- B. Remove "slop" created by the concrete finishing from all joints and edges.
- C. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
- D. Exposed macro fibers are to be removed using a propane torch and stiff brush after a minimum of 56-days curing of the concrete. Care should be taken to not overheat the concrete and cause it to be discolored, damaged or lose strength.

3.10 JOINT SEALING

A. All expansion joints are to be sealed. See Section 321373 for joint sealer requirements.

3.11 TOLERANCES

- A. Maximum Variation of Surface Flatness and Face Alignment: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.12 FIELD QUALITY CONTROL

- A. Allow an independent testing agency to perform field quality control tests, as specified in Division 1.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure four concrete test cylinders. Obtain test samples for every 25 cu yd or less of each class of concrete placed.
 - 1. Test fiber reinforced concrete prior to the addition of fiber and again after fiber has been added to set the baseline for the fiber reinforced compressive strength, slump and air content. This is to be done for the first pour of each mix design, and the results used for later pour strength requirements.
 - 2. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 3. Perform one slump test and one air content test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken. All test reports are to by typed.
- D. Any tests or time limits that do not meet the specified requirements are to be reported to the Contractor and that concrete shall be considered unacceptable.

3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic into curb/gutter area for 2 days minimum after finishing.
- C. Do not permit vehicular traffic into curb/gutter area until 75 percent design strength of concrete has been achieved.
- D. All concrete curb/gutter that is soiled or otherwise dirty are to be pressure washed and rinsed upon completion of the construction and landscaping work.

END OF SECTION

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Posts, rails, and frames.
- B. Wire fabric.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-Place Concrete: Concrete anchorage for posts.
- B. Section 087100 Door Hardware: Gate locking device.
- C. Section 337900 Site Grounding.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A428/A428M Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles; 2010 (Reapproved 2014).
- D. ASTM A491 Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; 2011.
- E. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete; 2015.
- G. ASTM F567 Standard Practice for Installation of Chain-Link Fence; 2011.
- H. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2014.
- ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2013.
- J. CLFMI CLF-SFR0111 Security Fencing Recommendations; 2014.
- K. FS RR-F-191/1D Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.
- L. CLFMI CLF 2445 Product Manual; 1997.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in installation of products specified in this section with not less than three years of documented experience.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fences and Gates:
 - 1. Master-Halco, Inc.: www.masterhalco.com.
 - 2. Merchants Metals: www.merchantsmetals.com.
 - 3. Stephens Pipe and Steel: www.spsfence.com
 - 4. Capitol Wholesale: www.capitolwholesale.com
 - 5. Substitutions: See Section 016000 Product Requirements.

2.02 COMPONENTS

- A. Line Posts: 1.9 inch diameter.
- B. Corner and Terminal Posts: 2.38 inch diameter.
- C. Gate Posts: 4 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Fabric: 2 inch diamond mesh interwoven wire, 6 gauge, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
- F. Tension Wire: 6 gauge, 0.1920 inch thick steel, single strand.
- G. Tie Wire: Aluminum alloy steel wire.

2.03 MATERIALS AND COMPONENTS

A. Materials and Components: Conform to CLFMI CLF 2445.

2.04 MATERIALS

- A. Posts, Rails, and Frames: :
- B. See Finishes Section for additional coatings/finish information
- C. Posts, Rails, and Frames: ASTM F1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 30 ksi.
- D. Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating.
- E. Line Posts: Type I round in accordance with FS RR-F-191/1D.
- F. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
- G. Wire Fabric: :
- H. ASTM A491 aluminum coated steel chain link fabric.

2.05 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

- C. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.
- D. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.
- E. Privacy Slats: Aluminum strips, sized to fit fabric.
 - Products:
 - a. PrivacyLink; Bottom Locking Double Wall Slats: www.eprivacylink.com/#sle.
 - b. SlatWarehouse; Tube Slat: www.slatwarehouse.com.
 - c. Pexco; PDS Commercial Fence Products Bottom Lock: www.pexco.com.
 - d. Substitutions: See Section 016000 Product Requirements.

2.06 FINISHES

- Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 oz/sq ft.
- B. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing.
- C. Accessories: Same finish as framing.
- D. Vinyl Coating Color(s): To be selected by Architect from manufacturer's standard range, minimum of four colors

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that areas are clear of obstructions or debris and ready for installation of fencing materials prior to installation..

3.02 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: ASTM F567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail _____. Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- H. Install center brace rail on corner gate leaves.
- I. Do not stretch fabric until concrete foundation has cured 28 days.
- J. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

- M. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- N. Ground fence in accordance with Section 337900.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.
- C. Do not infringe on adjacent property lines.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.

3.05 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.
- C. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

END OF SECTION

SECTION 329219 - SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Seeding, mulching and fertilizer.
- D. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 015713- Temporary Erosion and Sediment Control
- B. Section 312200 Grading: Topsoil material.
- C. Section 31 2200 Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
- D. Section 312323 Fill: Topsoil material.
- E. Section 312513 Permanent Erosion Controls:

1.03 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 SUBMITTALS

- A. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer; and watering instructions.
- B. Hydroseed product and maintenance data including a hydroseed physical sample. Submit dry hydroseed material in one gallon bag.
- C. If hydroseeding is to be used in combination with other seeding methods, the contractor is to submit plan for areas to receive each type of seeding method.

1.05 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- A. Furnish maintenance of seeded areas for three months after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SEED MIXTURE

A. Seed Mixture:

SEEDING 329219 - 1

- 1. Tall Fescue Grass Type: 40 percent. (Firecracker LS, Aggressor, Falcon IV, Col-M, 3rd Millenium or similar to be approved by the Landscape Architect).
- 2. Fine Fescue Grass Type: 30 percent. (Reliant IV, Firefly, Epic, Fortitude, Finelawn Petite or similar to be approved by the Landscape Architect)
- 3. Kentucky Blue Grass Type: 20 percent. (Freedom III, Blue Velvet, Midnight, Barrister, Nu Destiny, Quantum Lelap, Brilliant, Everglade or similar to be approved by the Landscape Architect).
- 4. Perennial Rye: 10 percent.
 - a. Approved Varieties:
 - 1) Manhattan 5
 - 2) Divine
 - 3) Secretariat II

2.02 SOIL MATERIALS

A. Topsoil: Type as specified in Section 312200.

2.03 ACCESSORIES

- A. Mulching Material: Wheat straw, free from seeds and weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Hydraulic Mulch: Fully biodegradable hydraulic mulch composed of 100% recycled wood fibers, cellulose fibers and wetting agents (including high-viscosity colloidal polysaccharides). The hydraulic mulch is to be sanitized, free from plastic netting, and upon application forms an intimate bond with the soil subsurface to create a porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth.
 - 1. Basis of design: SoilCover Blend with Tack by Profile Products, 750 Lake Cook Road, Suite 440, Buffalo Grove, IL 60089. p:800-508-8681, www.profileproducts.com.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Recommendations per the soil test.
- D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.04 TESTS

- A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, percentage inorganic matter soluble salt content, organic matter content, and pH value.
- B. Submit minimum 10 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.
- C. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.
- B. For areas that are graded with slopes less than 6:1, hydroseeding may be used in lieu of seed and mulch.

3.02 PREPARATION

A. Prepare subgrade in accordance with Section 312200.

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B. Place topsoil in accordance with Section 312200.

3.03 FERTILIZING

- A. Apply fertilizer as recommended in the soil testing results.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 3 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 SEEDING

- A. Apply seed at a rate of 7 lbs per 1000 sq ft or as recommended by the seed producer and/or soil testing, evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season: Timeframe for seeding is to be determined by the landscape architect in accordance with weather and project site conditions.
- D. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- E. Immediately following seeding and compacting, apply mulch to a thickness of 1/2 inches. Maintain clear of shrubs and trees.
- F. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.
- G. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

3.05 HYDROSEEDING

- A. Apply seed at a rate of 4 lbs per 1000 sq ft or as recommended by the seed producer and/or soil testing, evenly in two directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Apply 2000 lbs of hydraulic mulch with tack per acre or as recommended by the hydroseed manufacturer. Maintain clear of shrubs and trees. Contractor is to submit bill of materials to architect for quantity of materials delivered to site. Contractor is to have a manufacturer representative present on site during the first day of installation of hydraulic mulch.
- D. Contractor is to water hydroseeded area once every 7-days after hydroseeding for that area is complete or as recommended by the manufacturer.
- E. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

3.06 PROTECTION

- A. Identify seeded areas with stakes and string around area periphery. Set string height to 18 inches. Space stakes at 30 inches.
- B. Protect seeded areas in accordance with Section 312513 Permanent Erosion Controls

3.07 MAINTENANCE

A. Provide maintenance at no extra cost to Owner; Owner will pay for water.

SEEDING 329219 - 3

- B. See Division 1 Sections for additional requirements relating to maintenance service.
- C. Provide maintenance of seeded areas for three months from Date of Substantial Completion.
- D. Mow grass at regular intervals to maintain at a maximum height of 4 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- E. Neatly trim edges and hand clip where necessary.
- F. Immediately remove clippings after mowing and trimming.
- G. Water to prevent grass and soil from drying out.
- H. Roll surface to remove minor depressions or irregularities.
- I. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- J. Immediately reseed areas that show bare spots.
- K. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

SEEDING 329219 - 4

SECTION 329223 - SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Fertilizing.
- D. Sod installation.

1.02 RELATED REQUIREMENTS

- A. Section 312200 Grading: Topsoil material.
- B. Section 312200 Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
- C. Section 312323 Fill: Topsoil material.

1.03 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 REFERENCE STANDARDS

A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.05 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.06 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Certification: Submit certification of grass species and location of sod source.
- C. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.
- D. Submit sod watering schedule.
- E. Submit a planting schedule. Coordinate the schedule with the construction work of the project and with expected climatic conditions.
- F. Submit topsoil analysis reports. Provide subsoil analysis reports where needed.
- G. Submit a list of soil amendments as recommended by the topsoil and subsoil analyses and recommendations.

1.07 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Kentucky.

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B. Installer Qualifications: Company approved by the sod producer.

1.08 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sod on pallets. Protect exposed roots from dehydration.
- B. Do not deliver more sod than can be laid within 24 hours.
- A. Furnish service and maintenance of sodded areas for three months from Date of Substantial Completion.
- B. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
 - 1. Tall Fescue Grass Type: 40 percent. (Firecracker LS, Aggressor, Falcon IV, Col-M, 3rd Millenium or similar to be approved by the Landscape Architect).
 - 2. Fine Fescue Grass Type: 30 percent. (Reliant IV, Firefly, Epic, Fortitude, Finelawn Petite or similar to be approved by the Landscape Architect)
 - 3. Kentucky Blue Grass Type: 20 percent. (Freedom III, Blue Velvet, Midnight, Barrister, Nu Destiny, Quantum Lelap, Brilliant, Everglade or similar to be approved by the Landscape Architect).
 - 4. Annual Rye: 10 percent.
 - 5. Thickness: "Thick" sod, minimum 1 inch and maximum 1-3/8 inch topsoil base.
 - 6. Machine cut sod and load on pallets in accordance with TPI (SPEC) Guidelines.
- B. Topsoil: as specified in Section 312200.
- C. Fertilizer: per soil test requirements; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.
- D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.02 ACCESSORIES

A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

- A. Prepare subgrade in accordance with Section 312200.
- B. Place topsoil in accordance with Section 312200.

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3.03 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Align with adjoining grass areas. Top of sod surface to meet and match adjoining pavements.
- E. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- F. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.
- G. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

3.05 MAINTENANCE

- A. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.
- B. Mow grass at regular intervals to maintain at a maximum height of 3 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- C. Water to prevent grass and soil from drying out.
- D. Roll surface to remove irregularities.
- E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- F. Immediately replace sod to areas that show deterioration or bare spots.
- G. Protect sodded areas with warning signs during maintenance period.

END OF SECTION

SODDING 329223 - 3

SECTION 334100 - SUBDRAINAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building Perimeter and Retaining Wall Drainage Systems.
- B. French Drainage Systems
- C. Filter aggregate and fabric and bedding.

1.02 RELATED REQUIREMENTS

- A. Section 312316 Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- B. Section 312316.13 Trenching: Excavating and backfilling for site subdrainage systems.
- C. Section 312323 Fill: Backfilling over filter aggregate, up to subgrade elevation.

1.03 REFERENCE STANDARDS

- A. ASTM D2729 Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- B. AASHTO M 252M AND M 294M Corrugated PE Drainage Pipe and Fittings.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections, and connections to the storm water system.
- C. Product Data: Provide data on pipe drainage products, pipe accessories, and filter fabric.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents: Record location of pipe runs, connections, cleanouts and principal invert elevations.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Dual Walled Corrugated Plastic Pipe: Rigid type; 4 inch minimum diameter or as shown on the drawings, 10-foot or 20-foot lengths, with required fittings.
 - 1. Refer to Specifition Section 334101 for approved manufacturer's.
- B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.02 AGGREGATE AND BEDDING

A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 312323.

2.03 ACCESSORIES

A. Filter Fabric: Water pervious type, black non-woven, polypropylene, 6oz minimum weight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

SUBDRAINAGE 334100 - 1

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over-excavation with pipe bedding.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place filter fabric on clean cut subsoil or top of footing as indicated.
- C. Place drainage pipe on filter fabric.
- D. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- E. Place aggregate in maximum 4 inch lifts, consolidating each lift.
- F. Refer to Section 312323 for compaction requirements. Do not displace or damage pipe when compacting.
- G. Wrap filter fabric over levelled top surface of aggregate cover with minimum of 12-inches of overlap prior to subsequent backfilling operations. In cases where retaining wall waterproofing are required, lap the loosened section of drainage panel filter fabric over the filter aggregate fabric.
- H. Connect to storm sewer system with unperforated pipe, through installed sleeves.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.05 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins. **END OF SECTION**

SUBDRAINAGE 334100 - 2

SECTION 334101 - SITE STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Storm drainage piping, fittings, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 312316.13 Trenching: Excavating, bedding, and backfilling.
- B. Section 334413.23 Cleanouts and Drains
- C. Section 334413.13 Catch Basin and Curb Inlets
- D. Section 334903 Storm Drainage Outlets
- E. Section 334913 Storm Drainage Manholes

1.03 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.04 REFERENCE STANDARDS

- ASTM C 76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe;
 2008.
- B. ASTM C 76M Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]; 2008.
- C. ASTM C 443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2005a.
- D. AASHTO M 252M AND M 294M Standard Specification for Corrugated Polyethylene (PE) Drainage Pipe.
- E. ASTM F 667 Standard Specification for Large Diameter Corrugated Polyethylene (PE) Pipe and Fittings.
- F. ASTM F 447 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- G. ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and fittings.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents:
 - 1. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Concrete Pipe: Reinforced, ASTM C 76 (ASTM C 76M), Class III with Wall type B; mesh reinforcement; inside nominal diameter as identified on the drawings, bell and spigot end joints. Approved manufacturers include:
 - 1. Cloud Concrete Products
 - 2. Forterra (formerly Sherman Dixie)
- B. Reinforced Concrete Pipe Joint Device: ASTM C 443 (ASTM C 443M) rubber compression gasket joint.
- C. Corrugated PE Drainage Pipe and Fittings: Type S, dual wall with smooth waterway for coupling joints and PE sleeve with gasket material that mates with pipe and fittings to make them <u>watertight</u>. Approved manufacturers are:
 - 1. Advanced Drainage Systems, Inc., N-12 Pipe (www.ads-pipe.com)
 - 2. Timewell, Dual Wall Pipe(www.timewelltile.com)
 - 3. Baughman Tile Company, Dual Wall Pipe (www.baughmantile.com)
 - 4. Hancor, Blue Seal Pipe (www.hancor.com)
 - 5. Prinsco, Goldflow WT (www.prinsco.com)
 - 6. J.M. Eagle- product Eagle Corr Dual Wall Watertight Pipe. (www.jmeagled.com)
 - 7. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required wye, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. Trace Tape: Magnetic detectable conductor, clear plastic covering, imprinted with "Storm Sewer Service" in large letters.

2.03 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 312316.13.
- B. Cover: As specified in Section 312316.13.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 312316.13 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal sewer system.
- E. Install continuous trace wire 6 to 12 inches below finish grade, above pipe line; coordinate with Section 312316.13.

3.03 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Alignment: Piping where less than the full diameter of the inside of the pipe is not visible between structures will require replacement.
- D. Deflection Test: Piping with deflection that prevents passage of a ball or cylinder of size not less than 92.5 percent of piping diameter will require replacement.
- E. Piping that is crushed, cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- F. The contractor is to provide someone to remove and replace all grates or covers on storm water structures for any punch list visits that involve the storm water system.

3.04 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress. **END OF SECTION**

SECTION 334413.13 - CATCH BASINS AND CURB INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Catch basins.
- B. Precast concrete catch basins with grates, frames and accessories.

1.02 RELATED REQUIREMENTS

A. Section 015713 - Temporary Erosion and Sediment Controls for temporary inlet protection

1.03 REFERENCE STANDARDS

- A. ASTM A 48/A 48M Standard Specification for Gray Iron Castings; 2003.
- B. ASTM A 123/A 123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- C. ASTM C 913 Standard Specification for Precast Reinforced Concrete Water Structures; 2008.
- D. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections; 2007.
- E. ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2007.
- F. ASTM C 923M Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals [Metric]; 2007.
- G. ASTM D 3753 Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells; 2005.
- H. ASTM D3753 05e1 Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate structure identification designations, locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide structure data including configuration, grates, frames, steps and other components.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pre-Cast Structure Sections: Reinforced precast concrete in accordance with ASTM C 478 (ASTM C 478M), with resilient connectors complying with ASTM C 923 (ASTM C 923M).
- B. Approved Pre-Cast Concrete Manufacturers include:
 - 1. Oldcastle Precast
 - 2. Forterra (formerly Sherman-Dixie)
 - 3. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 CATCH BASIN AND CURB INLET COMPONENTS

- A. Concrete Structure Inlets:
 - 1. Catch Basin:
 - a. Grate Design: Per the storm drainage structure schedule on the drawings.

2.03 OTHER COMPONENTS

- A. Grate and Frame: ASTM A 48/A 48M, Class 30B Cast iron construction, machined flat bearing surface, removable grate, designed for H-20 loading; . Frames in pavement areas to allow for full asphalt pavement section to be located above the top of the concrete structure. Frames in landscape areas to be a minimum of 6-inches tall to allow for topsoil cover over top of concrete structure. Approved manufacturers include:
 - 1. J.R. Hoe and Sons
 - 2. Neenah Foundry Co.
 - 3. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.
- B. Inlet Structure Steps: Formed Poly-Coated Steel rungs; 3/4 inch diameter. Formed integral with structure sections.

2.04 CONFIGURATION

- A. Shape: As identified in the storm structure schedule on the drawings.
- B. Clear Inside Dimensions: as required for piping layout shown with 48 inch minimum diameter for circular structures.
- C. Design Depth: As indicated.
- D. Clear Lid Opening: 24 inches diameter.
- E. Pipe Entry: Provide openings as required.
- F. Steps: 12 inches wide, 16 inches on center vertically, set into structure wall. Steps are required for all concrete structures that are 42-inches deep or deeper from grate elevation to the bottom of the structure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for structure is correct.

3.02 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 INSTALLATION - CATCH BASINS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Establish elevations and pipe inverts for inlets and outlets as indicated.
- C. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.

- D. Mount grate and frame level in grout, secured to top slab to elevation indicated. Grate elevations shown on the drawings are for the highest point on the grate for combination inlets, and are the elevation where water will enter the structure for catch basins.
- E. All lift hook holes are to be grouted flush with the face of the structure using a hydraulic, non-shrink grout that will provide a finish to match that of the structure.
- F. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 sections for field inspection and testing requirements.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Structures and castings that are cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- D. The contractor is to provide someone to remove and replace all grates or covers on storm water structures for any punch list visits that involve the storm water system.

3.05 SCHEDULES

A. Storm Sewer Structures: See contract drawings for the storm structure schedule.

END OF SECTION

SECTION 334413.23 - CLEANOUTS AND DRAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cleanouts.

1.02 RELATED REQUIREMENTS

A. Section 0321313 - Concrete Paving.

1.03 REFERENCE STANDARDS

- A. ASTM A 48/A 48M Standard Specification for Gray Iron Castings; 2003.
- B. ASTM B 584-90 Copper Allow Sand Casting

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate structure identification designations, locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide structure data including configuration, grates, frames, steps and other components.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MATERIALS AND MANUFACTURERS

- A. Concrete: As specified in Section 321313.
- B. Concrete Reinforcement: As specified in Section 321313.
- C. Bronze: Copper Alloy No. 844
- D. Approved Manufacturers include:
 - 1. Zurn Industries
 - 2. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 CLEANOUT AND DRAIN COMPONENTS

- A. Grates and Covers: Bronze, hinged to frame.
 - 1. Cleanout:
 - a. Lid Design: Bronze with tamper resistant set screws; Textured Surface; Traffic Duty
 - b. Nominal Lid and Frame Size: 4 inches diameter.

2.03 ACCESSORIES

A. Concrete Pad: For components that are located in landscape areas, a concrete pad of a shape that matches that of the component is to be installed. The pad shall be shall be constructed in accordance with the requirements for concrete sidewalks, be a minimum of 4-inchs thick, and extend a minimum of 12-inches beyond the outer edge of the component. Refer to Section 321313 for concrete information.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for structure is correct.

3.02 PREPARATION

A. Coordinate placement of pipe and pavements required by other sections.

3.03 INSTALLATION

- A. Ensure pipe connections is adequately bedded and backfilled to prevent movement.
- B. Install component to proper elevation. Ensure top is level and protected against damage from concrete pad installation or other work.
- C. Where components are not located in paved areas, form and place cast-in-place concrete pad. Ensure the pad is finished per the sidewalk requirements with tooled edges, and is sloped for proper drainage away from the component.
- D. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.
- E. Clean and polish cover/grate to like new condition upon completion of work.
- F. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Components that are gouged, scratched, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- D. The contractor is to provide someone to remove and replace all grates or covers for any punch list visits that involve the storm water system.

END OF SECTION

SECTION 334903 - STORM DRAINAGE OUTLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete headwalls with grates and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A 48/A 48M Standard Specification for Gray Iron Castings; 2003.
- B. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections; 2007.
- ASTM C 478M Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric];
 2007.
- D. ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2007.
- E. ASTM C 923M Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals [Metric]; 2007.

1.03 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Shop Drawings: Indicate structure identification designations, locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide structure data including configuration, grates, frames, steps and other components .

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pre-Cast Headwalls: Reinforced precast concrete in accordance with Kentucky Transportation Cabinet requirements.
- B. All headwalls are to be in compliance with Kentucky Transportation Cabinet requirements.
- C. Approved Pre-Cast Concrete Manufacturers include:
 - 1. Oldcastle Precast
 - 2. Sherman-Dixie
 - 3. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 HEADWALL COMPONENTS

A. Grates: Rectangular steel bars, hot-dipped galvanized per Kentucky Transportation Cabinet standard drawings. Grates are to have security chains attaching them to the structure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.

C. Verify excavation for structure is correct.

3.02 PREPARATION

A. Coordinate placement of pipe required by other sections.

3.03 INSTALLATION - HEADWALLS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Establish elevations and pipe inverts for outlets as indicated.
- C. Set grate in recessed notches formed into the headwall wing walls, secure to top headwall with galvanized chain of a length that will allow removal for inspection.
- D. All lift hook holes are to be grouted flush with the face of the structure using a hydraulic, non-shrink grout that will provide a finish to match that of the structure.
- E. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Structures that are cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- C. The contractor is to provide someone to remove and replace all grates for any punch list visits that involve the storm water system.

3.05 SCHEDULES

A. Storm Sewer Headwalls: Refer to the storm structure schedule shown on the Contract Drawings. **END OF SECTION**

SECTION 334913 - STORM DRAINAGE MANHOLES, FRAMES AND COVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Modular precast concrete manhole sections with tongue-and-groove joints covers, anchorage, and accessories.

1.02 RELATED REQUIREMENTS

A. Section 015713 - Temporary Erosion and Sediment Controls for temporary inlet protection

1.03 REFERENCE STANDARDS

- A. ACI 530.1/ASCE 6/TMS 602 Specification For Masonry Structures; American Concrete Institute International; 2005.
- B. ASTM A 48/A 48M Standard Specification for Gray Iron Castings; 2003.
- C. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections; 2007.
- D. ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2007.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide manhole covers, component construction, steps, features, configuration, and dimensions.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C 478 (ASTM C 478M), with resilient connectors complying with ASTM C 923 (ASTM C 923M).

2.02 COMPONENTS

- A. Lid and Frame: ASTM A 48/A 48M, Class 30B Cast iron construction, machined flat bearing surface, removable lid, scheduled lid design; live load rating of H-20; lid molded with identifying name;
 Solid lids shall have the designation of "STORM" cast into the lid.
- B. Manhole Steps: #4 Bar with formed Copolymer Polypropylene Plastic coating rungs; 3/4 inch diameter. Formed integral with manhole sections.

2.03 CONFIGURATION

A. Shaft Construction: Concentric with eccentric cone top section as required; lipped male/female joints; sleeved to receive pipe sections. Top slab opening is to be per the drawings and steps are to be aligned with the lid/grate opening.

- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As required for shown pipe sizes and configurations. Structure diameter is to remain consistent from the bottom section to the cone or top slab that supports the casting.
- D. Design Depth: As indicated.
- E. Clear Lid Opening: 24 inches diameter minimum.
- F. Steps: 12 inches wide, 16 inches on center vertically, set into manhole wall. Steps are required for all structures that are 36-inches deep or deeper from grate/lid to bottom of structure. Top manhole step is to be no more than 24-inches from the lid/grate elevation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.02 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 MANHOLES

- A. Place concrete base pad, trowel top surface level.
- B. Place manhole sections plumb and level, trim to correct elevations and anchor as necessary.
- C. Cut and fit for pipe.
- D. Seal section and top joints with Conseal Sealant or approved equivalent.
- E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- F. Set cover frames and covers level without tipping, to correct elevations.
- G. Coordinate with other sections of work to provide correct size, shape, and location.
- H. Grout pipes to structure.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Structures that are cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- C. The Contractor shall provide someone to remove and replace all grates for any punch list visits that involve the storm water system. Contractor shall also provide all required equipment needed to meet OSHA confined space requirements associated with inspecting the drainage structure.

END OF SECTION

SECTION 334993 - DOWNSPOUT BOOTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Extruded Aluminum & Stainless Steel downspout boots.
 - 1. Contractors to provide extruded aluminum or stainless steel downspout boots.

1.02 RELATED REQUIREMENTS

A. Section 334101 - Site Storm Utility Drainage Piping.

1.03 REFERENCE STANDARDS

- A. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- B. AAMA 2604 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.
- C. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2005.

1.04 DESIGN REQUIREMENTS

Conform to applicable code for size and method of rain water discharge.

1.05 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- C. Product Data: Provide data on prefabricated components.
- D. Coordination Data: Provide table of downspout boots and their corresponding downspout size. Table should show boot top opening dimensions, downspout dimensions, boot length, boot outlet size and subsurface drainage pipe/fitting size.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Extruded Aluminum Downspout Boots: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Extruded Aluminum: McKinley Iron Works Type DS4 for connection to underground piping.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Or equal approved through addendum prior to bidding.
- B. Stainless Steel Downspout Boots: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:

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- 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and asthetics of the following:
 - a. Stainless Steel: Piedmont Manufacturing Type SO for connection for connection to underground piping.
- 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Or equal approved through addendum prior to bidding.

2.02 MATERIALS

- A. Extruded Aluminum Heavy duty extruded aluminum with integral fastening system.
 - 1. Length: As needed to have 24" above grade and a minimum of 6" below grade.
 - 2. Size: Coordinate with downspout sizes on Architectural plans
 - 3. Finish: Powder coat
 - 4. Color: Manufactor's standard color choices
- B. Stainless Steel: ASTM A666 Type 304, soft temper, 12 gauge thick.
 - 1. Length: As needed to have 24" above grade and a minimum of 6" below grade.
 - 2. Size: Coordinate with downspout sizes on Architectural plans
 - 3. Finish: Powder coat
 - 4. Color: Manufactor's standard color choices

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

3.02 PREPARATION

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil. Paint color is to match downspouts.
- B. All non-factory painted downspout boots are to receive one coat of primer and two coats of finish color paint prior to installation. A minimum of one additional coat of finish color paint is to be applied after installation. Any damage to paint or boot is to be repaired to like new condition. Paint color is to match downspouts as selected by Architect.

3.03 INSTALLATION

- A. Install downspouts and accessories in accordance with manufacturer's instructions.
- B. Connect downspouts to downspout boots at 24" above grade. Seal connection watertight.
- C. Connect downspouts to storm sewer system with the pipe connection and sleeve being completely below grade. Boot is to extend below grade a minimum of 6-inches. Offset of downspout boot is to be completely below finished grade. Seal connection watertight.
- D. Where downspout boots extend through concrete pavement, protect boot from concrete using plastic or other protective material for the entire height of the boot. If concrete materials come into contact with the downspout boot, removal and replacement of the boot may be required. Remove plastic protection after concrete work has been completed.
- E. Where downspout boots extend through concrete pavement, provide isolation joint material around the boot. After concrete installation, remove top 1/2-inch of isolation joint material and install joint sealant in accordance with Section 321373- Pavement Joint Sealants.

END OF SECTION

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