



**2013 Bond Program
Series 2, Bid Package #19**

**Larson MS Office Renovation, IAE storage room and interior
door replacements (various buildings)**

PROJECT MANUAL

Issued: February 15, 2017

Barton
 **Malow**



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PROJECT MANUAL
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- Division 0 Conditions of The Contract and Division 1 General Requirements are found in the Project Manual, included herein
- Project Manual issued by Barton Malow Company dated February 15, 2017
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REFER TO PROJECT MANUAL BOOK 2: TECHNICAL SPECIFICATIONS ISSUED BY TMP
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**SECTION 00030
PROJECT MANUAL
INFORMATION AND IDENTITIES**

This Project Manual has been prepared by CM and contains the Bidding and Contract Requirements for **Troy School District – 2013 Bond Program – Series 2, Bid Package 19 Larson Office Renovation , IAE storage room, Interior Door Replacement (various buildings)** project in Troy, MI

PROJECT:

**Troy School District 2013 Bond Program
Series 2, Bid Package 19
Larson Office Renovation , IAE storage room,
Interior Door Replacement (various buildings)**

**CONSTRUCTION MANAGER:
(Direct all Questions to CM)**

**Barton Malow Company
1140 Rankin Drive
Troy, MI 48083**

**Christa Amalio
Phone: 586.295.1412
Email: Christa.Amalio@bartonmalow.com**

OWNER:

**Troy School District
1140 Rankin
Troy, MI 48083**

ARCHITECT:

**TMP Architecture
1191 W. Square Lake Road
Bloomfield Hills, MI 48302
Phone: (248) 338-4561**

SECTION 00100
Advertisement to Bid

1. Barton Malow Company requests Bid Proposals on behalf of Troy School District for the construction of the **Series 2, Bid Package 19 - Larson Office Renovation, IAE storage room, Interior Door Replacement (various buildings)**.

Bid Proposals will be received:

- 1.1. By delivery or mail, no later than 10:30 AM local time on March 1, 2017.
- 1.2. To the attention of:

Todd Hensley
Troy School District
1140 Rankin
Troy, MI 48083

2. Proposals must be sealed with Bidder's name on the outside of the envelope and designated as follows:

Sealed Proposal

Series 2, Bid Package 19-
Larson Office Renovation , IAE storage room, Interior Door
Replacement (various buildings)

Bid Category:

06000 – General Trades
230000 – Mechanical
230000 – Temperature Controls
260000 – Electrical

Contractor Name, Address, Phone Number

3. Proposals shall be based on the requirements set forth in the Bidding Documents:

Bid Category:

060000 – General Trades
230000 – Mechanical
230000 – Temperature Controls
260000 – Electrical

4. Accepted Bidders will be required, as a condition precedent to award of Contract, to furnish, satisfactory Performance Bond and Payment Bond, and Certificates of Insurance as required in the Project Manual.
5. Unless otherwise specifically set forth, this Project is subject to state sales and/or use taxes, and Bidder is required to include such taxes in its Bid Proposal.
6. Barton Malow Company has been contracted by the Owner in the capacity of CM for the Project, and shall act as representative of the Owner to the extent required/allowed under its Owner contract. Hereafter Barton Malow Company shall be referred to as the "CM".

7. Bid Proposals will be publicly opened by Troy School District, evaluated by CM, Owner and the Architect, with recommended awards subsequently made by Barton Malow Company. ***The Owner shall not open, consider, or accept a Bid Proposal that is received after the date and time specified for bid submission in this Advertisement for Bids.***
8. Bidding Documents will be available for examination and distribution on or after February 15, 2017.
9. No Pre-bid meeting will be scheduled for Bid Package 19. Building will be available for walk-throughs on February 20 and 21, 2017 and can be coordinated with Christa Amalio at Christa.Amalio@bartonmalow.com.
10. Electronic documents are free of charge and are made available by emailing: Christa.Amalio@bartonmalow.com.
11. Bid Proposals shall be on forms furnished by CM. Bidders will be required to submit with their Bid Proposals a Bid Security by a qualified surety authorized to do business in the state where the Project is located. Bidders shall not withdraw Bid Proposals for a period of 90 Days after date for receipt of Bid Proposals.
12. The successful Bidder(s) will be required to enter into an agreement with **Troy School District** on the Agreement Form identified in the Project Manual.
13. All Bid Proposals shall be accompanied by the following two forms found in Section 00410: Familial Disclosure Form (in accordance with MCL 380.1267) and an Iran Economic Sanctions Act Form (in compliance with Michigan Public Act No. 517 of 2012. Bid Proposals that do not include these two sworn and notarized forms shall not be accepted.

Barton Malow Company
Christa Amalio
Project Manager

END OF SECTION 00100

SECTION 00200 INSTRUCTION TO BIDDERS

1. DEFINITIONS

- 1.1. Capitalized terms used in this Project Manual shall have the meanings set forth below. If a capitalized term is used herein but not defined in this Section, 00200, Part 1, it shall have the meaning set forth in the Contract Documents.
- 1.2. “**Addenda**” means the written and graphic instruments issued by the Architect and/or CM prior to the execution of the Agreement that modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
- 1.3. “**Agreement**” means the document defined in the Project Manual, including all other documents incorporated by reference in the Agreement.
- 1.4. “**An Alternate Bid**” (or “**Alternate**”) is an amount stated in the Bid Proposal to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.
- 1.5. “**Architect**” means the person or entity listed in section 00030 of the Project Manual and may include professional engineers if so designated.
- 1.6. “**Base Bid**” is the sum stated in the Bid Proposal for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added to or deducted from for sums stated in Alternate Bids.
- 1.7. A “**Bidder**” is a person or legal entity that submits a Bid Proposal in conformance with the Bidding Documents. After award of the Agreement, the Bidder will be referred to as Contractor. All Contractors on this project are considered prime/principal contractors.
- 1.8. “**Bid Categories**” are units of Work performed by a Contractor and its Subordinate Parties which form part of the total Project. The term “Bid Category” should not be confused with the term “**Technical Section**”. Technical Sections of the Specification establish quality and performance criteria, and the Bid Categories designate work scope and assignment.
- 1.9. “**Bidding Documents**” means the Bidding Requirements, the Contract Documents, and the Reference Documents collectively.
- 1.10. A “**Bid Package**” means a series of Bid Categories that are released for bidding in the same set of Bidding Documents.
- 1.11. “**Bidding Requirements**” include the Advertisement to Bid, Instructions to Bidders, Information Available to Bidders, and Bid forms and supplements.
- 1.12. “**Bid Proposal**” is a complete and properly signed proposal to do the Work of an individual Bid Category(ies) for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.13. The “**Contract Documents**” consist of all Contracting Requirements set forth in the Project Manual, including, but not limited to, the Contract Forms (the Agreement, Performance/Payment Bonds, and Certificates), the Conditions of the Contract (General, Supplementary or Special), the General Requirements of the Project Manual, the Technical Specifications, Drawings, and all other documents incorporated into the Agreement by reference, all Addenda issued prior to and all modifications issued after execution of the Agreement.
- 1.14. “**Contractor**” means the entity to which the Owner issues a contract for performance of the Work.
- 1.15. “**Day**” means calendar day, unless otherwise defined in the particular Contract Document.
- 1.16. “**Hazard Communications Program**” means Contractor’s own hazard communications program that will govern project safety for its Work. The Hazard Communications Program must be submitted to CM by each successful Bidder before commencing Work and be no less stringent than Section 00810 - On Site Safety and Loss Control Program.

- 1.17. **“Hazardous Materials”** means asbestos; asbestos containing material; lead (including lead-based paint); PCB; molds; any other chemical, material, or substance subject to regulation as a hazardous material, hazardous substance, toxic substance, or otherwise, under applicable federal, state, or local law; and any other chemical, material, or substance that may have adverse effects on human health or the environment.
- 1.18. **“Lowest Responsive, Responsible Bidder”** means a Bidder who’s Bid Proposal conforms in all material aspects to the terms, conditions, specifications and requirements of the solicitations and who has demonstrated the ability to properly perform the Work.
- 1.19. **“MBE/WBE/SBE”** means Minority Owned Business Enterprise/Women Owned Business Enterprise/ Small Business Enterprise as these terms are defined in the applicable ordinances and laws governing the Project.
- 1.20. **“Project Safety Program”** means the Contractor’s site safety program that will govern project safety for its Work. The Project Safety Program must be submitted to CM by each successful Bidder before commencing Work and be no less stringent than Section 00810 - On Site Safety and Loss Control Program.
- 1.21. **“Reference Documents”** are drawings that do not form a part of the Contract Documents and are included in the Bidding Documents as a courtesy only. The Bidder is not entitled to rely upon the accuracy of the Resource Drawings and they are not warranted to be correct or reliable by the Owner or CM. The Bidder is expected to have conducted its own investigation into the reliability or accuracy of any Reference Documents, and no adjustment to the Base Bid shall be made if such request arises or results from the Bidder’s failure to conduct such investigation.
- 1.22. **“Subordinate Parties”** means all of Contractor’s employees, workers, laborers, agents, consultants, suppliers or subcontractors, at any tier, who perform, assist with, or otherwise are involved in any of the Work.
- 1.23. A **“Unit Price”** is an amount stated in the Bid Proposal as a price per unit of measurement for materials or services as described in the Bidding Documents or in the proposed Contract Documents.
- 1.24. The **“Work”** includes all work and responsibilities performed or to be performed by Contractor under the Subcontract.

2. PART 2 - BIDDERS REPRESENTATIONS

- 2.1.1. The Owner reserves the right to request qualification forms or additional information from any Bidder before issuing documents, receiving Bid Proposals or awarding an Agreement. The Owner may, at their sole discretion, accept or reject Bidders as qualified. The right to waive any informalities or irregularities in qualification materials is reserved by the Owner.

2.2. BIDDER BY MAKING ITS BID REPRESENTS THAT:

- 2.2.1. Bidder has carefully read, reviewed and understands the Bidding Documents and its Bid Proposal is made in accordance therewith.
- 2.2.2. Bidder’s Bid Proposal is based upon the materials, systems, equipment, terms and conditions required by the Bidding Documents without exception.
- 2.2.3. Bidder certifies that it:
 - 2.2.3.1. has examined the Project site;
 - 2.2.3.2. has carefully reviewed the Bidding Documents
 - 2.2.3.3. has compared its examination of the Project site with the Bidding Documents;
 - 2.2.3.4. is satisfied as to the condition of the Project site, any surface or subsurface obstruction, the actual levels, and all excavating, filling in, removal and demolition, measurements and quantities involved in the Work;
 - 2.2.3.5. is familiar with weather conditions of the Project area;
 - 2.2.3.6. has taken account of all of these factors in preparing and presenting its Bid Proposal.

- 2.2.4. Bidder further certifies that it
 - 2.2.4.1. has fully acquainted itself with the character and extent of the Owner's, CM's and other Contractor's operations in the area of the Work
 - 2.2.4.2. has taken account of coordination of operations of others in its construction plans set forth in the Bid Proposal.
- 2.2.5. No change orders will be issued to the Contractor for or on account of costs or expenses occasioned by its failure to comply with the provisions of this paragraph, or by reason of error or oversight on the part of the Contractor, or on account of interferences by the Owner's, CM's or other contractor's activities.
- 2.2.6. The Bidder, by submitting its Bid Proposal, represents that it has carefully reviewed the project schedule, along with the related requirements of the Project's Schedule and Phasing, and acknowledges that these are acceptable and have been taken into account in preparing its Bid Proposal.

3. BIDDING DOCUMENTS

3.1. COPIES

- 3.1.1. Bidders shall use complete sets of Bidding Documents in preparing Bid Proposals. Neither the Owner, CM nor the Architect shall be responsible for errors, omissions or misinterpretations resulting from the Bidder's use of partial sets of Bidding Documents.
- 3.1.2. Copies of the Bidding Documents are being made available for the purpose of obtaining Bid Proposals for the Work only. Bidders shall not use the Bidding Documents for any other purpose. Neither the Owner, CM nor the Architect warrants the completeness and/or adequacy of the Bidding Documents.

3.2. INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

- 3.2.1. Bidder shall promptly notify the Barton Malow Company of all ambiguities, inconsistencies, or errors that it may discover upon examination of the Bidding Documents or upon examination of the Project site and local conditions. Bidders requesting clarification or interpretation of the Bidding Documents shall make a written request, which shall reach Barton Malow Company at least 5 days prior to the date for receipt of Bid Proposals. Direct all questions to:

Contact Name: Christa Amalio
Address: 1140 Rankin
City, State, Zip: Troy, MI, 48098
Phone: 586.295.1412
Email: Christa.Amalio@bartonmalow.com

- 3.2.2. Any interpretation, correction, or change of the Bidding Documents will be made by Addendum and/or Bid Clarification. Interpretations, corrections, or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes. Advertisement to Bid

3.3. ADDENDA and/or BID CLARIFICATIONS

- 3.3.1. Addenda and/or Bid Clarifications will be distributed to all who are known by CM to have received a complete set of Bidding Documents. Copies of Addenda and/or Bid Clarifications will be made available for inspection wherever Bidding Documents are on file for that purpose.
- 3.3.2. No Addenda or Bid Clarifications will be issued later than 3 days prior to the date for receipt of Bids except an Addendum or Bid Clarification withdrawing or postponing the request for Bid Proposals.

3.4. ALTERNATES

- 3.4.1. Each Bidder must bid on all Alternates listed in the Bid Proposal that are applicable to its Bid Category. Alternates will be fully considered in awarding the Agreement.
- 3.4.2. The Owner shall be allowed a period of 90 Days after date of receipt of the Bid Proposals to exercise the right to accept or reject any or all Alternates submitted on the Bid Proposal.
- 3.4.3. Successful Bidders shall perform all Work required for complete execution of accepted Alternates, and the Bid Proposal shall include all overhead and profit for the Work required.

3.5. VOLUNTARY ALTERNATES

- 3.5.1. All Bid Proposals must be based upon the Bidding Documents. In addition to a Base Bid Proposal, the submission of Voluntary Alternates is acceptable and encouraged. If a Voluntary Alternate is submitted for consideration, it shall be expressed on the Bid Form as an add or deduct amount from the Base Bid. The [Owner or Owner and CM] reserve the right to unilaterally accept or reject Voluntary Alternates and to determine if the Voluntary Alternates will be considered in the awarding of the Agreement.

3.6. UNIT PRICES

- 3.6.1. Each Bidder must bid on all Unit Prices listed in the Bid Proposal that are applicable to its Bid Category. Unit Prices will be fully considered in awarding the Agreement.
- 3.6.2. Successful Bidders shall perform all Work required for complete execution of accepted Unit Prices, and such Unit Prices shall include all overhead and profit for the Work required.

3.7. NO DISCRIMINATION

- 3.7.1. All Bidders shall ensure that employees and applicants for employment are not discriminated against because of their race, color, religion, sex, national origin, age, marital status, sexual orientation, or disability and in conformance with local, state and federal laws, regulations and ordinances.
- 3.7.2. In regard to any Agreement entered into pursuant to this Bid Package, minority and women owned business enterprises will be afforded full opportunity to submit Bid Proposals and will not be discriminated against on the grounds of race, color, religion, sex, national origin, age, marital status, sexual orientation, disability or any other status protected by applicable law.

4. BIDDING PROCEDURE

4.1. FORM AND STYLE OF BIDS

- 4.1.1. Bid Proposals shall be submitted in accordance with the Bid Proposal Form.

4.2. BID SECURITY

- 4.2.1. Bid security in the form of a bid bond issued by a qualified surety, certified check or cashier's check in the amount of five percent (5%) of the Base Bid amount will be required at the time of submission of the Bid Proposal. Bid bonds shall be duly executed by the Bidder, as principal and by a surety that is properly licensed and authorized to do business in the state in which the Work is to be performed. All sureties providing bonds for this Project must be listed in the latest version of the Department of Treasury's Circular 570, entitled "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies", with the bond amount less than or equal to the underwriting limitation, and/or have an A.M. best rating of A- or better.
- 4.2.2. Bid bond shall pledge that the Bidder, with the understanding that if its Bid Proposal is accepted, will enter into the Agreement with the Troy School District for any of the Bid Category(ies) accepted from its Bid Proposal and will, if required, furnish performance and payment bonds covering the faithful performance of the Agreement and the payment of all obligations arising there under. The attorney-in-fact, who signs the surety bond, must submit along with the bond, a certified and effectively dated copy of his/her power of attorney.

- 4.2.3. Bid bond form AIA Document A310 unmodified, is approved for use on this Project.
- 4.2.4. The bid security obligees shall be Troy School District and the amount of the bid security shall become their property in the event that the Bidder fails, within fifteen (15) days of notice of award or receipt of the Agreement form, to execute the Agreement, and deliver the performance and payment bonds as described in the Project Manual, section 00500. In such case, the bid security shall be forfeited to the Troy School District as liquidated damages, not as a penalty.
- 4.2.5. The Owner will have the right to retain the bid security (ies) of Bidders to whom an award is being considered until either (a) the Agreement has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bid Proposals may be withdrawn, or (c) all Bid Proposals have been rejected.
- 4.2.6. Bid security will be returned to the successful Bidders after the Agreement has been executed, and acceptance of required performance and payment bonds. The bid security of Bidders that are not under consideration for award of the Agreement will be returned to those Bidders.

4.3. SUBMISSION OF BIDS

- 4.3.1. All copies of the Bid Proposal, the bid security and any other documents required to be submitted with the Bid Proposal shall be enclosed in a sealed opaque envelope. The envelope shall be labeled as specified as noted in Section 00100.
- 4.3.2. Bid Proposals shall be deposited at the designated location prior to the time and date for receipt of Bid Proposals indicated in the Advertisement to Bid, or any extension thereof made by Addendum or Bid Clarification. Bid Proposals received after the date and time for receipt of bids may be returned unopened.

4.4. MODIFICATION OR WITHDRAWAL OF BID PROPOSAL

- 4.4.1. A Bid Proposal may not be modified, withdrawn or canceled by the Bidder after the stipulated time period and date designated for the receipt of Bid Proposals, and each Bidder so agrees in submitting its Bid.
- 4.4.2. Prior to the time and date designated for receipt of Bid Proposals, any Bid Proposal submitted may be modified or withdrawn by notice to the party receiving Bid Proposals at the place designated for their receipt. Such notice shall be in writing over the signature of the Bidder.
- 4.4.3. Withdrawn Bid Proposals may be resubmitted up to the time designated for the receipt of bids provided that they are then fully in conformance with these Instructions to Bidders.
- 4.4.4. Bid security as stated above shall be in an amount for the Base Bid as modified or resubmitted.

5. CONSIDERATION OF BIDS

5.1. OPENING OF BIDS

- 5.1.1. Bid Proposals received on time will be opened publicly.
- 5.1.2. Bid Proposals shall be held open and irrevocable for ninety (90) Days after the date for receipt of bids.

5.2. REJECTION OF BIDS

- 5.2.1. The Troy School District reserves the right to reject any or all Bid Proposals in accordance with all applicable laws.

5.3. ACCEPTANCE OF BID (AWARD)

- 5.3.1. It is the intent of the Troy School District to award the Agreement to the Lowest Responsive and Responsible Bidder in accordance with the Bidding Documents. The Troy School District shall have the right to waive any informality or irregularity in any Bid Proposal received and to accept Bid Proposals which, in its judgment, are in its own best interest.

- 5.3.2. The Troy School District shall have the right to accept Alternates in any order or combination and to determine the low Bidder on the basis of the sum of the Base Bid, Voluntary Alternates and Alternates accepted.
- 5.4. To the extent that these Instructions to Bidders and applicable public bidding laws, rules, regulations or ordinances conflict with each other, the provisions of the applicable bidding laws, rules, regulations or ordinances shall govern.
- 5.5. The Owner expects all supplies, materials equipment or products proposed by a Bidder to meet or exceed the Specifications set forth in the Bidding Documents. Further, it is the Owner's intent that the Bidding Documents permit competition. Accordingly, the use of any patent, proprietary name or manufacturer's name is for demonstrative purposes only and is not intended to curtail competition. Whenever any supplies, material, equipment or products requested in the Bidding Documents are specified by patent, proprietary name or by the name of the manufacturer, unless stated differently, such specification shall be considered as if followed by the words "or comparable equivalent," whether or not such words appear. The Owner, in its sole and absolute discretion, shall have the right to determine if the proposed equivalent products/brands submitted by Bidder meet the Specifications contained in the Bidding Documents and possess equivalent and/or better qualities. It shall be the Bidder's responsibility to notify the Owner in writing if any Specifications or suggested comparable equivalent products/brands require clarification by the Owner prior to the Due Date for Bid Proposals.

6. POST BID INFORMATION

6.1. POST BID INFORMATION

- 6.1.1. After the Bids are received, tabulated, and evaluated, the apparent low Bidders when so requested shall meet with CM at a post-bid meeting for the purposes of determining completeness of scope and any contract overlaps or omissions. If requested, the Bidder shall submit additional information as requested by CM. The Bidder will provide the following information at the post-bid meeting:
 - 6.1.1.1. Designation of the Work to be performed by the Bidder with its own forces including manpower for the Contractor and that of its Subordinate Parties.
 - 6.1.1.2. Detailed cost breakdown of the Bidder's Bid Proposal including labor, equipment and material unit prices.
 - 6.1.1.3. A list of names of the Subordinate Parties proposed for the principal portions of the Work.
 - 6.1.1.4. The proprietary names and suppliers of principal items or systems of materials and equipment proposed for the Work.
 - 6.1.1.5. The names and backgrounds of the Bidder's key staff members including foremen and assistants. Bidder shall be requested to establish the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.
 - 6.1.1.6. Commitment to construction schedules, identification of items requiring long lead deliveries and manpower information in accordance with Section 00230 of the Project Manual.
 - 6.1.1.7. Signed safety program compliance, as described in the Contract Documents
- 6.1.2. Prior to award of the Agreement, CM will notify the Bidder if either the Owner, the Architect, or CM, after due investigation, has reasonable objection to any proposed Subordinate Party. If the Owner, Architect or CM has reasonable objection to any proposed Subordinate Party, the Bidder may, at its option: (1) withdraw its Bid Proposal; or (2) submit an acceptable substitute Subordinate Party with an adjustment in its bid amount to cover the difference in cost occasioned by such substitution. The Troy School District, may, at its discretion, accept the adjusted bid amount or it may disqualify the Bidder. In the event of either withdrawal or

Disqualification under this Subparagraph, bid security will not be forfeited, notwithstanding the terms in the Instructions to Bidders.

- 6.1.3. Upon the Award of the Agreement, the Contractor shall submit to CM a complete list of all items, products, and layouts for which shop drawings, brochures, or samples are required; name of each Subordinate Party; and date of planned submission.
- 6.1.4. The Bidder will be required to establish to the satisfaction of CM, Owner and Architect, the reliability and responsibility of the Subordinate Parties proposed to furnish and perform the Work described in the Bidding Documents.

END OF SECTION 00200

SECTION 00210
DESCRIPTION OF THE WORK/SPECIAL PROVISIONS

1. GENERAL

1.1. RELATED DOCUMENTS

- 1.1.1. All Bidders shall review all of the Bidding Documents, all Bid Category Work descriptions and all Contract Documents, immediately advise CM of any adverse factors, conflicts or ambiguities that might affect the execution of Work of this Bid Package. Each Bidder is responsible to review all Bid Category descriptions and Contract Documents and coordinate the Work accordingly. Each Bidder shall incorporate into its Bid Proposal the cost of coordination of the Work with the requirements of all related Contract Documents, as shown, specified, or required.
- 1.1.2. Each Bidder shall thoroughly examine all of the Bidding Documents for the Work of all trades so as to familiarize itself both with the Work required under its Bid Category(ies) and with Work required under all other Bid Categories.
- 1.1.3. The Bidder shall perform all Work reasonably inferable from the Bidding Documents to produce the intended results. Bidders are required to visit and examine the Project site and may arrange the visit through CM.
- 1.1.4. A complete set of bid documents are available at CM's office

1.2. PROJECT DESCRIPTION

- 1.2.1. The scope of work includes renovation to the Larson Middle School office area, IAE storage room and interior door replacements at various buildings throughout the district. Specific Bid Category/Work Scope descriptions are found in Section 00220.
- 1.2.2. NOTE: a list of owner pre-purchased equipment will be provided in the addendum

1.3. SUMMARY OF THE BID CATEGORIES/WORK SCOPES

- 1.3.1. The following is a listing of Bid Categories for this project. All work relative to the Bid Package is identified on plans and specifications as prepared by the Architect. Each Bid Category description identifies the scope of Work to be performed by the Bidder as designated by CM.

BID CATEGORIES

06000 – General Trades
230000 – Mechanical
230000 – Temperature Controls
260000 – Electrical

1.4. SPECIAL PROVISIONS

- 1.4.1. The following special provisions form a part of each Bid Category Work Scope and apply to each Contractor's Scope of Work found in Section 00220.
- 1.4.2. The Bid Category/Work Scopes should in no way be construed as being all inclusive. The Work Scope is issued as a guide to aid in the assignment of Work. If conflict regarding assignment of Work exists between the drawing notes and these descriptions, the Description of the Work and Bid Category/Work Scopes will take precedence. The Contractor shall carefully review and compare the Drawings and Specifications with the Work Scopes, and if a conflict

exists, the Contractor shall immediately notify CM in writing. The Bid Category numbers and the specification section numbers are not, in all cases, identical.

- 1.4.3. Bidders are required to bid the entire Bid Category. Bids will only be accepted for individual Bid Categories. A Bidder may bid more than one Bid Category. Combined bids covering several Bid Categories will not be accepted, unless separate bid amounts are listed for each Bid Category making up the combined bid amount. Review the “Instructions to Bidders” in Section 00200 for specific Bid Proposal instructions.
- 1.4.4. Each Bidder shall review the schedule enclosed in the Bidding Documents, and be prepared to review at the post-bid meetings a schedule for the engineering, fabrication, delivery and installation of its Work. . This information will be considered in the award recommendation.
- 1.4.5. All Contractors are to coordinate all Work with the work of other trades for proper function and sequence (see Section 01360). Contractor must furnish approved copies of shop drawings, mock-ups, and technical data to other contractors designated by the CM for the purposes of coordination of this Work. Contractor must provide to all other trades all information (drawings, diagrams, templates, embedments) and other related Work necessary for the proper coordination of the Work of all trades. Each phase of the Work shall be coordinated, and the coordination plan approved by CM prior to proceeding. Contractor shall keep informed as to Work of all trades engaged in the Project, and shall execute Work in such a manner as not to delay or interfere with the progress of other trades involved. Contractor is required to schedule its Work so that no other party is delayed in execution of its work. Contractor is required to employ competent supervision on the Project throughout the entire period of construction to ensure proper coordination.
- 1.4.6. Contractor will furnish before any Work is started, evidence of ISO Certification or documented procedures for process control, including drawings, submittals, inspection/surveillance and training. In lieu of defined procedures, Contractor will follow CM’s documented procedures for process control.
- 1.4.7. When it is necessary to modify or tie into existing utility services, Contractor shall notify CM in writing a minimum of 48 hours prior to the planned disruption. All disruptions shall be scheduled with CM and shall be kept to a minimum time. Tie-ins and shutdowns of existing utilities may have to be performed during off hours. Contractors are to include any required premium time in the Base Bid.
- 1.4.8. If Owner will occupy the premises or a portion of the premises during the construction, Contractor shall cooperate with CM and Owner in all construction operations to minimize conflict, and to facilitate Owner occupancy.
- 1.4.9. Information pertaining to the existing building has been obtained through photographs and investigations and is indicated on the Resource Drawings. This information is not warranted to be complete or accurate. Contractor shall verify all dimensions in the field prior to ordering materials or construction and any costs or expenses arising out of its failure to do so shall be borne solely by Contractor.
- 1.4.10. The Contractor shall examine the existing site conditions and carefully compare them to the Drawings. All measurements must be verified from actual observation at the Project site. The Contractor is responsible for all Work fitting in place in approved, satisfactory and workmanlike manner in every particular. If the Contractor encounters unexpected existing site or building conditions, it shall cease operations immediately to minimize damage and shall immediately notify CM in writing. Contractor shall bear all costs, expenses or damages arising or resulting from its failure to comply with this paragraph.
- 1.4.11. Hoisting of material or equipment above occupied areas will NOT be permitted unless the existing structure has been properly verified by a licensed professional Engineer to be able to bear the load of the material or equipment being hoisted if accidentally released. It is the responsibility of the Contractor performing such hoisting to properly and adequately reinforce existing structure.

- 1.4.12. Space for electrical and mechanical lines is limited for the Project. Therefore, it is imperative that Contractor coordinate its Work with the Work of all other trades to ensure containment of electrical and mechanical lines in space provided. Priority of space will be decided in discretion of CM, with no additional compensation, where unresolved conflict exists. If Work is not properly coordinated, Contractor shall remove and relocate Work without additional compensation.
- 1.4.13. The Contractor shall maintain all project record documents for all concealed Work to mark actual construction. The Contractor shall turn over to CM all project record documents upon completion of Work by the Contractor, in a format to be determined by CM. The Contractor shall make all project record documents available to the Owner, CM and/or the Architect for inspection and review. The Contractor's failure to maintain such documents adequately shall entitle the Owner and/or CM to withhold payment until such documents are current and up to date.
- 1.4.14. The Contractor shall submit a daily report to CM on a daily basis on the form provided to Contractor by CM.
- 1.4.15. All Contractors shall attend all meetings as required by CM.
- 1.5. OWNER EQUIPMENT COORDINATION
 - 1.5.1. The Owner Furnished and Contractor Installed (OF/CI) equipment as listed in the Individual Contractor's Work scopes found in Section 00220 shows the Contractor responsible to schedule delivery, receive the equipment and accessories F.O.B. jobsite, inspect, protect, store, handle and move into position, provide all coordination with applicable trades for rough-in requirements and final connections, marshal the appropriate trades as a composite installation crew, and assist in initial startup.
 - 1.5.2. Refer to the Drawings to determine quantities.

END OF SECTION 00210

BID CATEGORY 06 10 00 – CARPENTRY / GENERAL TRADES

The work of this bid category includes but is not limited to providing all labor, equipment, materials, scaffolding, hoisting and incidentals to complete all the **Architectural Demolition, Doors, Fames, Drywall, Acoustical Ceilings, and Specialties** in accordance with the specifications, drawings and applicable codes. All work is to be performed as shown on the plans and specified in the following technical specification sections:

<u>Specification Section</u>	<u>Description of Section</u>
<u>DIVISION 01 – GENERAL REQUIREMENTS – ALL</u>	
<u>DIVISION 02 – EXISTING CONDITIONS</u>	
024119	Selective Demolition
<u>DIVISION 04 – MASONRY</u>	
042000	Unit Masonry Assemblies
<u>DIVISION 05 - METALS</u>	
055000	Metal Fabrications
<u>DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES</u>	
061000	Rough Carpentry
<u>DIVISION 07 – THERMAL AND MOISTURE PROTECTION</u>	
078413	Firestopping
079200	Joint Sealants
<u>DIVISION 08 – DOORS AND WINDOWS</u>	
081113	Standard Steel Doors and Frames (2 spec sections provided.
Reference BP 19 spec and Interior Doors Spec in Interior Doors Folder)	
081416	Flush Wood Doors
087100	Door Hardware
088000	Glazing
<u>DIVISION 09 - FINISHES</u>	
092900	Gypsum Wallboard Assemblies
093000	Tile
095113	Acoustical Ceilings
096815	Carpet Tile
099100	Painting
<u>DIVISION 10 – SPECIALTIES</u>	
102226	Operable Partitions

In addition to the above, this bid category includes but is not limited to the Bidding Documents, the Bidding and Contract requirements and Division 1 General Requirements of the Project Manual and various other Technical Specifications interfacing with this work. The bidder is advised to review the work descriptions of the other categories and other referenced documents so as to not misunderstand scope responsibilities.

THE SCOPE OF THIS BID CATEGORY SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING ITEMS:

1. It is the responsibility of this Bid Category to review all drawings & drawing notes, including civil, architectural, structural, mechanical, and electrical drawings, and include items requiring work that is

generally defined as the responsibility of this Bid Category within the work description unless otherwise noted above in the scope of work.

2. This contractor will be responsible for all re-mobilization costs for all phases of work.
3. This contractor is to provide all legal disposal off-site of the debris that is a result of their work.
4. Coordinate the location and sizes of all openings with the appropriate trades.
5. Before sawcutting or making any cuts in the floor, all contractors must use ground penetrating radar, and must provide proof that it was used, to the Barton Malow site superintendent.
6. Furnish, install and maintain all shoring and bracing as required. Leave shoring in place until new building systems are in place and then remove as required. Prior to installation of shoring and bracing efforts, provide shop drawings on the proposed shoring and bracing design. A registered engineer in the State of Michigan must seal drawings.
7. This contractor shall be responsible for receiving, off loading, hoisting into/onto building including the safe and secure storage of materials related to this work.
8. This contractor shall provide joint sealants at all control joints.
9. Provide all frames, steel doors, hardware, and access doors as specified on the construction documents and drawings.
10. Contractor will be responsible for delivery and off-loading of all frames at the site and will need to verify correct quantity of frames on shipper with the Barton Malow site superintendent.
11. The contractor is responsible to schedule a keying meeting with the school district to determine keying requirements for new cores. Contractor to coordinate with owner key/core supplier to make the system match high security system.
12. Remove tags and clean all surfaces after new doors and panels are installed.
13. Contractor will be responsible for storing all doors and frames in an acceptable manner with Barton Malow and Architect. Contractor will be responsible for removing any rust which may appear on the steel doors and frames.
14. Provide and install all insulation required for this contractor's work.
15. Provide all backing, wood blocking and shims for proper anchorage, as required, for work of this category and others, to include specialties, countertops, wood trim work, toilet accessories, and equipment.
16. Where drawings indicate an architectural item to be removed and relocated, this contractor will be responsible for all work associated with the removal and re-installation of that item.
17. Coordination with other trades, including mandatory participation in job meetings.
18. Provide and install complete gypsum wallboard, cement board, framing, layout, insulation backing, drip edges, metal edge angles, sealants, expansion joint assemblies, backer rods, through-wall flashing, control joints, including all accessories. This contractor is responsible for providing final wall construction to meet code requirements.
19. Provide and install complete cold-formed metal framing system (interior and exterior) including design and engineering, as specified.

20. Provide labor and material to perform all taping, sanding and finishing of drywall and plaster surfaces to degree ready for acceptance of final wall treatment and obtain approval for application of all finishes.
21. Provide and install all insulation, sealers, vapor barriers and soundproofing material behind work of this category.
22. Seal drywall partitions up against structural steel or deck and provide fire safing materials to close all penetrations through partitions, as specified. Sealing of drywall walls shall meet all fire rating codes.
23. Contractor is responsible for repairing areas where nailpops, ridging, etc., occurs or openings in drywall for backboxes are too large for cover trim or plate.
24. Install all access doors for proper access to equipment and devices of other trades in acoustical ceilings, gypsum board, cementitious coatings and plaster construction. Access panels required by other trade Contractors, whether shown or not shown, will be furnished by the same and installed by this contractor.
25. Coordinate all embedded items incorporated in this work including, but not limited to, mechanical and electrical equipment for proper alignment leveling and access.
26. Provide and install complete acoustical ceiling system including all framing, layout, insulation, backing, ceiling tiles, break metal closures, anchorage and hangers. Coordinate layout of mechanical and electrical fixtures with those trades. Complete all mechanical/electrical cuts required by other trades.
27. This contractor is responsible for re-working the ceiling grid for the installation of the own work.
28. Provide and install additional support members and furring channels for hangers required to support their own work around mechanical and electrical fixtures; including the condition when it is necessary to span ducts, pipes and structural members.
29. Provide all light gauge metal framing required for interior and exterior construction and accessories including but not limited to parapets, as specified.
30. Contractor is to include a \$15,000 allowance to be used for providing and installing temporary walls.
31. Where drawings indicate an architectural item to be removed and salvaged, this contractor will be responsible for all work associated with the removal and re-installation of that item. Refer to architectural plans.
32. All interior doors are to be delivered with hardware installed prior to delivery to the jobsite.
33. Fabrication and installation of all structural steel framing, columns, beams, girts, sag rods, joists and girders, metal decking, bracing, connections, steel tube framing, roof ladders, staircases, pipe railings, temporary bracing and erection materials (as required), miscellaneous support steel and miscellaneous iron, as specified. Perform all work in accordance with all contract document notes, sections, details and column key plans. This contractor is responsible to review the extent of the work under this category and include any necessary, relocation and/or replacement of existing items to complete work. Field fabrication to meet existing conditions may be required. Refer to demo notes for further clarification.
34. Furnish all loose steel lintels, shelf angles, anchor bolts, masonry anchors, support angle, set irons, bearing plates, leveling plates, sleeves, and relief angles to the appropriate trades for installation. Refer to demo notes.
35. When the lintel schedule allows option of using either precast or steel lintels, the Masonry contractor shall furnish and install precast lintels.

36. Fabricate, deliver, and unload, as directed, all miscellaneous iron and embedment to the appropriate categories.
37. Weld all miscellaneous steel and embedment required by other trades.
38. Furnish and install angle framing and decking closures for all roof penetrations including ductwork, exhaust fans, roof hatches, shown to be removed by the demo contractor.
39. Provide all closure angles and steel angles with anchors as required for masonry and concrete work. Turnover to appropriate contractor.
40. Include cleaning and touch up painting of bolted connections, welded connections, and abraded areas. After erection, field coat all abrasions, nuts and bolts, washers and surfaces left unpainted.
41. Shop painting and field touch-up painting for structural steel members.
42. Furnish loose lintels for all wall penetrations, which require structural support. This contractor will be responsible to examine all drawings (Structural, Architectural, Mechanical and Electrical) for openings requiring support steel or items requiring structural support. Layout elevations of lintels to be supplied to the installation contractor in the field. Coordinate the layout elevations with Mechanical and Masonry Contractors.
43. Reinforce existing structural steel as shown or required for installation of new work. It is this contractor's responsibility to review all structural, architectural and mechanical drawings. Remove, patch and/or replace any ceiling systems as required to perform work of this category.
44. Work shall be performed in accordance with the General Structural Steel notes listed and details shown.
45. Verify all elevations, grades, etc., prior to installation, necessary to complete this scope of work and provide Barton Malow Company a copy of the report.
46. Furnish and install miscellaneous structural steel for mechanical support unless indicated by other trades as shown in the Contract Documents.
47. Reference Structural Detail sheets for joist bearing at firewall detail, all plates are to be supplied by this bid category. Plates scheduled to be install in existing wall will be installed by the masonry contractor. All plates scheduled to be installed at new steel are to be installed by the steel contractor.
48. Supply and install all handrails and guardrails shown on the drawings, include the civil drawings
49. Perform all trimming and adjusting of demolition work for installation of new construction. Coordinate limits of wall demolition with architectural drawings and all critical trade contractors.
50. Deliver maintenance stock to Owner, as specified.
51. Install expansion joints as noted for your scope of work.
52. Provide and install paint for all interior surfaces, exterior surfaces, exterior lintels, concrete floors, mechanical lines fire protection lines, and duct work, as required, including epoxy painting work. Gas lines shall be painted yellow, per code.
53. This contractor is responsible to investigate the completed surfaces of all walls, ceilings, soffits, etc., of drywall, masonry and other construction to determine and approve finishes established by those trades to which all work of this category applies. Prepare all surfaces to receive paint as specified, including all minor repairs.

54. Contractor is responsible for removing or covering all cover plates, trim pieces, etc., necessary for the performance of their work if directed by the appropriate trade and replacing same at the conclusion of this Contractor's work.
55. Provide finishing for all wood surfaces requiring on-site finishing
56. Contractor is responsible for selective touch-up of finish work per the Architect and Construction Manager.
57. Contractor is responsible for all touch-up of door frames after installation of doors and glass.
58. The contractor is responsible to protect all floors from overspray to the approval of the Construction Manager.
59. This contractor is responsible to paint all new, exterior, exposed piping, including the new gas line on the roof.
60. Provide all necessary information, color samples and finish samples, and cooperate with the Project Architect in the development of the colors and finishes.
61. Contractor is responsible for all caulking of dissimilar materials
62. Furnish and install all interior and exterior concrete masonry units, above and below grade, bond beams, face brick, pre-cast lintels, glazed concrete masonry units, glass unit masonry, joint materials, dampproofing, waterproofing, insulation, compressible fillers, backer rod, anchors, ties, bearing plates, reinforcing, through-wall flashing and drip edges, building paper, weep holes, premolded expansion strip, exterior and interior caulking and sealant, anchor bolts and other accessories shown or required for a complete product. Perform work in accordance with related notes/details listed on structural, architectural drawings and masonry wall key plans.
63. This contractor shall set the hollow metal frames supplied by the carpentry contractor. Provide labor and materials to grout all hollow metal frames as specified or required. Check frames for plumb and square during the frame installation and before doors are to be installed. Correct any deficiencies in plumbness, levelness and squareness.
64. This contractor is responsible for all masonry cleaning and sealing. Provide all cleaning and scraping of masonry walls to receive paint. Following the application of block filler, the bidder shall remobilize and correct aesthetic deficiencies as noted by Owner, Architect, and/or Construction Manager.
65. Coordinate the location and sizes of all openings with the appropriate trades. Provide appropriate opening in walls for all mechanical equipment - HVAC, architectural louvers, etc. set in masonry construction. Coordinate closely with mechanical trades for opening sizes and locations
66. This contractor is responsible to review the code plan. Seal masonry partitions up against structural steel or deck and provide safing insulation or grouting to close all penetrations through partitions, as specified. Sealing of masonry walls shall meet all fire rating codes
67. Unload, handle, and install all miscellaneous iron items furnished by others such as steel lintels, anchors, shelf angles and relieving angles supplied by others.
68. Provide and install all grouting for the bearing plates, sills and other items, as required.
69. Provide and install foamed-in-place insulation as required. Insulation is to be installed prior to painting of walls.
70. Grout all masonry units below grade.

71. Contractor to tooth in door frames, pipe chases, unit ventilators as noted or otherwise required to complete this category.
72. Provide CMU infill where existing windows, doors, louvers, etc. have been removed. Tooth in brick to match existing.
73. Install sleeves furnished by other trades.
74. Furnish and install sealant within exterior and interior masonry wall construction and when masonry abuts an existing dissimilar surface.
75. Cutting of masonry walls for installation of electrical/plumbing/fire extinguisher cabinets/technology boxes provided by others are this contractor's responsibility within masonry walls. The electrical and carpentry contractors will share the responsibility and any cost incurred for adjustment to ensure a square/plumb quality finished project.
- 76. Only wet cutting will be permitted on silica containing material.**
77. Provide and install all concrete reinforcements, curing compounds, control joints, expansion joints, joint sealants, caulking, fillers, and related accessories, as specified.
78. Furnish and install all cast-in-place concrete for the entire plans and specifications, including but not limited to, foundations, perimeter walls, floors, piers, slab-on-grade, thickened slabs, grade beams, stairs, ramps, steps, recessed floor mats, and exterior stoops. Furnish and install rigid insulation on compacted granular fill as required. All work is to be performed in accordance with General Foundation and Concrete Noted listed and related notes/details on structural and architectural drawings.
79. Remove spoils when unsuitable for re-use. Import engineered fill when necessary.
80. Provide and install all concrete reinforcements, dowels, woven wire fabric, control joints, expansion joints, joint sealants, caulking, fillers, and related accessories, as required. Consolidate and remove all left over re-steel at the end of the job.
81. Supply and install all required surface treatments, sealers, and curing compounds for all concrete floors, including all preparation and cleaning required.
82. Provide and install all required foundation insulation, vapor barrier, protective board, and all other related accessories.
83. Include shoring and underpinning of existing footing
84. Blank off panels for the gymnasium shall be furnished and installed by the mechanical contractor. General Trades is to provide painting at blank off panels as noted on the plans.
85. Furnish and install operable partitions as noted on the drawings and specifications.
86. Furnish and install all tile and carpet tile as noted on the bid documents.
87. Furnish and install metal fabrications as noted on the bid documents.
88. Furnish and install wood doors, steel frames and hardware noted on bid documents
89. Furnish and install all glazing noted on plans and specs.
90. Include an allowance \$20,000 to be used per the discretion of Barton Malow Company.
91. All extras must be submitted within 60 days, or cost will be voided.

EXCLUDED FROM THIS CONTRACTOR'S WORK IS:

1. None

SPECIAL CONSIDERATIONS:

1. All demolition work is assigned to the individual contractors that are responsible for the particular material or work in question. The contractor is to perform all demolition of the materials assigned in the specification sections listed in their own Description of Work, unless otherwise noted.
2. No deliveries will be accepted in or out of the construction site during the hours of 7:30am – 8:30am and 3:00pm – 4:00pm
3. Provide adequate supervision of your sub-contractors and your field personnel. This includes a field superintendent responsible for all work with the ability to make decisions.
4. Every contractor performing Demolition of any type must provide a person who is trained and certified in lead renovation. This “certified lead renovator” must be on site at all when demolition work is occurring. The contractor must also meet all new OSHA, MOSHA, and DEQ requirements regarding lead. Contractors will be required to supply their firm’s name and copy of the certifications of the “Certified Lead Renovator” card as well as a copy of their firm’s certifications as a startup document. All other photo documentation requirements as required under the regulation will be required to be provided during the “closeout” phase of construction (as well as a copy maintained by the contractors for 3 years after date of substantial completion). The contractors will be required to post a notification packet in the buildings notifying all occupants of the upcoming renovations. Please visit the EPA’s website www.EPA.gov/lead for more information.
5. Prevailing Wage Rates apply to all bid categories.

END OF BID CATEGORY 06 10 00 – CARPENTRY / GENERAL TRADES

WORK SCOPE

BID CATEGORY 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

The work of this bid category includes, but is not limited to providing all labor, equipment, materials, scaffolding, hoisting and incidentals to complete all **instrumentation and control for HVAC work** in accordance with the specifications, drawings and applicable codes. All work is to be performed as shown on the plans and specified in the following technical specification sections:

DIVISION 1 - GENERAL REQUIREMENTS - All

DIVISION 20 – COMMON MECHANICAL REQUIREMENTS – ALL (AS IT RELATES)

DIVISION 22 – PLUMBING – ALL (AS IT RELATES)

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING – ALL (AS IT RELATES) **and 230933 – Temperature Controls**

DIVISION 26 – ELECTRICAL – ALL (AS IT RELATES)

In addition to the above, this bid category includes, but is not limited to the Bidding Documents, Bidding and Contract Requirements, Division 1 - General Requirements of the Project Manual, and various other Technical Specifications interfacing with this work. The bidder is advised to review the work descriptions of the other categories and other referenced documents, so as to not misunderstand scope responsibilities.

THE SCOPE OF WORK IS TO INCLUDE, but is not limited to the following items:

1. Provide all new instrumentation and control equipment and systems indicated on the drawings. This work shall be all control equipment as required for the mechanical systems, including but not limited to: plumbing, fire protection, domestic water piping, hydronic systems, chiller systems, and HVAC work indicated, and components required for a complete system.
2. Obtain approvals and provide all required permits, fee applications, etc., required for execution of work. Pay for inspection fees for same. Coordinate the inspection and testing of the systems with state and local governing agencies. Pay for all fee and testing charges in conjunction with the testing of each system.
3. Provide all cost to complete the interlocking of the smoke duct detectors as required. Provide and install all equipment required to complete this work.
4. Monitor and coordinate all dampers and VFDs with BMS and Fire Alarm System.
5. Furnish to the contractor constructing the walls, floors and ceilings, all access panels required to service the mechanical systems that are not shown on the drawings.
6. Perform all check, test, start-up and commissioning per contract documents.
7. Provide complete owner training on controls system. Provide evidence of training upon completion of session(s).
8. Coordinate graphics/front ends with Owner and Designer of record

9. Provide fire stopping as necessary to seal wall, floor and ceiling penetrations created for work under this bid category. Note: Fire stopping must adhere to all building codes and State Fire Marshal requirements.
10. Review the electrical specification and provide any electrical equipment required for control equipment that is required for a complete installation, but not shown.
11. Provide all troubleshooting and diagnosis of malfunctioning mechanical systems, including control work.
12. Rigging and hoisting for work of this Bid Category.
13. Caulk all products installed by this Contractor, where required for work of this Bid Category.
14. Receive, unload, store and protect all control equipment.
15. Protect the work of this contract, as required.
16. Provide final cleaning of all equipment installed by this bid category prior to Owner occupancy.
17. Coordinate overhead work with all trades.
18. This contractor will be responsible to remove and reinstall any ceiling tile necessary to complete all work under this bid category. This contractor will be responsible to replace any ceiling tiles that are damaged during this process.
19. Provide daily cleanup according to Barton Malow standards, including daily removal of all materials and debris related to this category. You must provide your own dumpster.
20. Each contractor, while on site shall provide to Barton Malow one (1) person for each five tradesmen (or portion thereof) employed at the site, one day a week for up to four (4) hours , for the exclusive purpose of performing overall project weekly cleanup. Please refer to section 1550 page two in regards to direct cleanup, weekly cleanup and final cleanup.
21. Submit all shop drawings and product submittals on materials within two (2) weeks of letter of intent. No partial submittals will be accepted. Contractor will be held responsible for damages due to late shop drawings and product submittals.
22. Review all specifications and project drawings, drawing notes, schedules, and schedule notes including architectural, mechanical, and electrical for areas requiring work described by this bid category and coordinate work with the respective contractors, include all costs in base bid.
23. Protect existing equipment and items to remain during construction including existing ceilings, walls, and flooring. Contractors are to protect all existing floors and existing owners materials remaining on site. Include protection of existing buildings and finishes within the pathway through the building from the construction area to the exterior. Correction of damage due to lack of adequate protection will be the responsibility of this contractor. In addition, all work is to be performed through existing ceilings, be it lay in, spline, drywall, or plaster, etc. Contractors are to include the cost of repairing and patching, removal and reinstallation and replacement of ceilings as required for work of their bid category.
24. Use of the elevator is not permitted. Include all rigging and hoisting to deliver and remove materials to / from the second floor.
25. Contractor shall have full time supervision including while their subcontractors are on-site.

26. Include all manpower, overtime, and composite crews in base bid to complete work per schedule. See section 00230.
27. The temperature control contractor is responsible for working with the district's commissioning agent to commission all new and existing valves and dampers throughout Barnard, Bemis, Wass and Administration Building.
28. All layout required for work of this bid category.
29. Contractor must be certified by one of the specified temperature controls manufacturers as listed in the specifications.
30. Demolition of all temperature controls items and system as shown, where mechanical equipment is demoed, and/or required for work of this bid category. The demolition work shall include all supporting items and hangers, unless shown to remain. Coordinate demolition activities with the Owner in order to maintain existing mechanical systems. Provide and install any temporary measures to keep the existing mechanical system operational for temporary heat. Coordinate with the mechanical contractor.
31. Provide firestopping at all new/re-used floor and wall penetrations. Include weather tight patching at exterior penetrations.
32. Furnish and install complete temperature controls system including but not limited to all related wiring, conduit, transformers, relays, monitoring devices, and equipment as shown, specified, or required for a complete installation.
33. Provide all sensor wells and control valves to the Mechanical Contractor for installation. All controls piping and wiring and secondary power wiring for control valves shall be completed by this Controls Contractor. Provide cutsheets on valves to the mechanical and testing & balancing contractor after submittal approval.
34. Obtain a permit from Barton Malow prior to any hot work. Provide all safety measures. Protect all existing construction during any and all hot work done by this bid category.
35. Label temperature control points on stats, junction boxes, and equipment as specified and/or per Troy Schools standards. Provide a detailed printed description. Label ceiling grid where VAV box controls are located.
36. Contractor is responsible for storage of all materials. Deliver materials to the site as needed. Storage in the building will be limited.
37. Coordinate controls with new mechanical equipment for a fully operational system.
38. Contractor responsible for coordinating all work with Mechanical Contractor.
39. Contractor responsible for obtaining copies of all approved mechanical equipment submittals from Mechanical Contractor.
40. Contractor is responsible to coordinate the installation of controls on vav boxes with the mechanical manufacturer. Coordinate with the Mechanical contractor.
41. Contractor is to setup remote access to the frontend with Troy Schools.
42. Contractor shall maintain a work deficiency list while onsite. Update weekly and submit to the mechanical contractor and copy the construction manager.
43. Contractor shall include time in the bid to work with the test and balance contractor.
44. Contractor shall verify in writing that the controls system is fully operational and operating correctly prior to test & balancing, commissioning and punchlist.
45. Contractor shall include time in the bid for commissioning.
46. Provide and install all operating tools for the control graphics system.
47. Cutting, patching, and coring for installation of new work shown or required for work of this bid category.

48. All wiring should be in a minimum of ½" conduit including temperature controls unless otherwise noted on the drawings.
 49. All adjusting and cleaning shall be performed as specified per each spec section.
 50. Items shown to be turned over to Owner must be accompanied by a transmittal and copied with signature of receipt to BMC.
 51. Provide as-built drawings, manufacturer's warranties, and O/M manuals. Provide in-service training to Owner's staff on all systems and equipment as required. Training may not start until o/m manuals are approved by the architect and as-builts have been received. Warranties on equipment or systems will not start until owners training has been completed. Contractor is to provide extended warranties from the manufacture as necessary for compliance of the above mentioned.
 52. Punch list will not start until all work has been completed.
 53. All start-up and training is to be performed by a factory certified representative or manufacturer (as required per specification section) for that specific piece of equipment.
 54. All field quality control and equipment commissioning shall be conducted per each specification section. A written itemized report shall be submitted to the construction manager verifying each individual item has been completed with all back-up field and test reports.
 55. In addition to the contractors one year warranty on parts and labor, submit all extended warranties called out in the specifications.
 56. When work covered by a warranty with a specific time period has failed and has been corrected by Contractor, the warranty shall be reinstated for a time period equal to the original warranty.
 57. Provide extra materials as specified.
 58. Contractors may not drop retainage to 5% until all warranties, o/m manuals, testing, commissioning, training, extra materials, and punchlist items have been completed, turned over, accepted, and documented. Contractors must also have up to date partial and final waivers from subcontractors and suppliers including a G707 form signed and sealed by the surety.
 59. To bill out the remainder of retainage (from 5% to 0%), the contractor must set up a meeting with BMC to go over and/or collect the remaining closeout items for final payment (including all final waivers) as specified in section 01700 of this project manual.
60. SAFETY:
- It is this contractor's responsibility to provide full fall protection per Barton Malow requirements. Any workers found deficient will be permanently removed from the jobsite
 - Provide each worker within this category with a hardhat (newer than 5 years old), safety glasses, reflective safety attire, work gloves, and other PPE required to perform job per the Barton Malow safety requirements. This is required at all times while working onsite. Failure to provide will result in removal of worker from site. Please review Barton Malow safety manual for specifics.
 - All contractors are to take part in Barton Malow's stretch and flex program daily and turn a sign in sheet with daily report with those who participated in the program. Please review the Barton Malow safety manual for specifics.
 - All contractors must provide a person who is trained and certified in working around lead materials. This "certified lead renovator" must be on site when all demolition is occurring or when lead materials are effected by construction. Proof of training and a certificate must be provided to Barton Malow during submittal phase confirming the training of the individual. The contractor must also meet all new Federal, OSHA, MIOSHA, and DEQ requirements regarding lead.

- Each person working on site shall review the BMC safety orientation video before beginning work. Each contractor shall submit documentation that all of their employees have viewed the video.

Excluded:

1. Testing and balancing
2. Installation of control valves provided to the Mechanical Contractor
3. Occupancy Sensors (provided and installed by Mechanical Contractor)

SPECIAL CONSIDERATIONS:

1. This project is subject to the State of Michigan Prevailing Wage. Review the Labor Relations section for prevailing wage rates for this project. Monthly certified payroll must be made available upon request.
2. All work under this scope shall comply with proper trade jurisdictions, even if it is necessary to assemble composite crews or subcontract to appropriate trades.
3. Bid proposals must be per plan and specs. Bids not conforming to plans and specifications will be rejected. Substitutions must be pre-approved in writing prior to bids or be submitted as voluntary alternates on the bid form.
4. All contractors are to field verify all existing conditions prior to submitting a bid. Submitting a bid is acceptance of all field conditions. Do NOT scale the drawings. All dimensions must be verified in the field.
5. Anyone listed on the National Sex Offender List is not allowed to be a part of this project and anyone who is convicted of a listed offense will be immediately dismissed from project. Provide photo identification upon arriving to the site and badges are to be worn by Contractor's field personnel at all times.
6. Provide photo identification badges to be worn by Contractor's field personnel at all times.
7. Contractor is responsible to furnish all Barton Malow Company start-up documents and submit submittals within two (2) weeks of contract award. This includes signed contract, bonds, certificate of insurance with CG 20 10 01 85 AND CG 20 37 10 01 endorsements, schedule of values, contact list, signature list, sub/supplier list, site specific safety program, MSDS's, and the Barton Malow Company Safety Certificate (section 01600). The submittal register will be issued at award of contract. Each contractor and office engineer is to attend a 2-Part Construction Kick-Off and Pre-Construction Meeting.
8. Bidder shall complete the Bid form in its entirety, special attention is directed to the Labor Rate, Alternates and Unit Prices Section of the Bid Form.
9. This Bidder is required to submit alternate prices identified in the Bidding Documents, which pertain to their work. These alternate prices must be separate from their base bid on the Bid Proposal Form as described in Section 00200 Instructions to Bidders.
10. The special provisions outlined in Section 00210 Description of the Work form a part of this bid category work description and apply to this bidder's scope of work.
11. All bidders are required to review the General Conditions of the contract located in Section 00700.
12. Every contractor performing Demolition of any type must provide a person who is trained and certified in lead renovation. This "certified lead renovator" must be on site at all when demolition

work is occurring. The contractor must also meet all new OSHA, MOSHA, and DEQ requirements regarding lead. Contractors will be required to supply their firm's name and copy of the certifications of the "Certified Lead Renovator" card as well as a copy of their firm's certifications as a startup document. All other photo documentation requirements as required under the regulation will be required to be provided during the "closeout" phase of construction (as well as a copy maintained by the contractors for 3 years after date of substantial completion). The contractors will be required to post a notification packet in the buildings notifying all occupants of the upcoming renovations. Please visit the EPA's website www.EPA.gov/lead for more information.

13. According to new EPA federal mandate, beginning April 2010 contractors performing work that disturbs lead-based paint in schools built before 1978 must be EPA certified and follow specific work practices to prevent lead contamination. It will be the responsibility of all contractors on site to follow proper work practices to prevent lead contamination. For more information, please review section 00810.
14. This contractor is responsible to create a safety binder which will include the following information: site specific safety program, signed safety agreement (01600), MSDS sheets, Asbestos Training Certificates, CPR/first aid certificates, Lift certifications, Lead Renovators Certificates, MIOSHA 30 training Certificates, Storm Water Certificates, Equipment Maintenance Logs, Equipment Training Letters, Roof Work Permits, & Letter indicating competent person. This information will be organized and clearly marked with the contractors name, address and division on the exterior of a 3 ring binder for each building you will be working at, include this safety binder as an item on your schedule of values with a value of \$1,000.00.
15. Provide daily clean-up and weekly unidentifiable clean-up, according to Barton Malow standards, including subcontractors for work of this bid category. If daily clean-up and weekly unidentifiable clean-up is not performed, the construction manager will provide labor to complete the clean-up and the appropriate contractors will be back charged.
16. If contractor is behind schedule and is notified by Barton Malow Company, the contractor shall be required to accelerate the work at its own expense. The contractor shall employ such means as overtime work, multiple work shifts, and additional equipment, and shall continue to do so until the progress of the work, in the opinion of Barton Malow, is in conformance with the master project construction schedule.

END OF BID CATEGORY 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

BID CATEGORY 23 00 00 – MECHANICAL

The work of this bid category includes but is not limited to providing all labor, equipment, materials, scaffolding, hoisting and incidentals to complete all the **Mechanical** in accordance with the specifications, drawings and applicable codes. All work is to be performed as shown on the plans and specified in the following technical specification sections:

<u>Specification Section</u>	<u>Description of Section</u>
<u>DIVISION 01 – GENERAL REQUIREMENTS-ALL</u>	

DIVISION 02 – EXISTING CONDITIONS

024120	Selective Demolition
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DIVISION 05 - METALS

055000	Metal Fabrications
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DIVISION 07 – THERMAL AND MOISTURE PROTECTION

078413	Firestopping
079200	Joint Sealants

DIVISION 20 – COMMON MECHANICAL REQUIREMENTS - ALL**DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING – ALL**

In addition to the above, this bid category includes but is not limited to the Bidding Documents, the Bidding and Contract requirements and Division 1 General Requirements of the Project Manual and various other Technical Specifications interfacing with this work. The bidder is advised to review the work descriptions of the other categories and other referenced documents so as to not misunderstand scope responsibilities.

THE SCOPE OF THIS BID CATEGORY SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING ITEMS:

1. It is the responsibility of this Bid Category to review all drawings & drawing notes, including civil, architectural, structural, mechanical, and electrical drawings, and include items requiring work that is generally defined as the responsibility of this Bid Category within the work description unless otherwise noted above in the scope of work.
2. Each category shall be responsible for items of work as described in Section 00210 Descriptions of Work/Special Provisions/Requirements.
3. This contractor to review the scope of work for bid category 16000, division 16 Electrical, for work related to this bid category. If there is any confusion to the scope of work for each related bid category, this contractor shall submit a pre-bid RFI, or clarify on the proposal form the point of confusion, and clarify what work has not been included in the bid. This contractor will coordinate with the work of bid category 16000 contractor in the areas of wiring mechanical equipment, valve alarm flow switches, duct detectors, control wiring for mechanical equipment, etc. and should thoroughly familiarize themselves with the electrical requirements relative to the bid category 16000 work.
4. Review the electrical specifications and provide any electrical equipment required for mechanical equipment which is required for a complete installation, but not shown. The electrical contractor will be responsible for a single point connection to mechanical equipment.
5. This contractor will be responsible for all re-mobilization costs for all phases of work.

6. This contractor shall be responsible for receiving, off-loading, hoisting into/onto building including the safe and secure storage of materials related to this work.
7. This contractor is to provide all legal disposal off-site of the debris that is a result of their work.
8. Coordinate the location and sizes of all openings with the appropriate trades.
9. Furnish and install pipe identification markers, tags, schedules, nameplates to identify ducts, pipes and mechanical equipment.
10. Before sawcutting or making any cuts in the floor, all contractors must use ground penetrating radar, and must provide proof that it was used, to the Barton Malow site superintendent.
11. Furnish, install and maintain all shoring and bracing as required. Leave shoring in place until new building systems are in place and then remove as required. Prior to installation of shoring and bracing efforts, provide shop drawings on the proposed shoring and bracing design. A registered engineer in the State of Michigan must seal drawings.
12. Perform all trimming and adjusting of demolition work for installation of new construction. Coordinate limits of wall demolition with architectural drawings and all critical trade contractors.
13. In all locations where this contractor sawcuts the floor, this same contractor is also responsible for pouring back concrete. This contractor must coordinate with flooring contractor as to provide proper floor finish and height.
14. For the duration of your work, all building systems must remain operational and there shall be no interruption to the owner's systems while they are occupying the building. Coordinate and schedule shut-downs as required for this contractors work during off-hours.
15. Include shutting off main water line, heating systems, and draining down systems complete in base bid. Perform this work on weekends not to interfere with owner's operations or other trade activities. DO NOT assume that any branch shutoffs in base bid are existing.
16. Contractor is responsible for removal of all spoils resulting from their work from the site.
17. The first floor sub-grade will be placed and compacted prior to the start of the underground work designated in this package. This contractor is responsible to excavate, install work and replace all fill to the specified density material within the building interior to the same condition it was prior to starting excavation for underground. Remove spoils from site.
18. Provide piping and connections to site utilities, as shown. This contractor is responsible to terminate connections 5 feet outside of building. Contractor is responsible for all excavation, backfill and compaction for their work. All backfill must be Class II granular fill. Coordinate connections with Category 320000.
19. This contractor is to verify and stake locations of all underground utilities before beginning their work.
20. Coordinate with Architect/Engineer before penetrating any structural members.
21. Furnish and install all new louvers including architectural louvers, as specified. Outside air louvers are to be electrostatic painted by this contractor. Coordinate with all other trades for the location and size of all openings for louvers.
22. This contractor is responsible for covering and securing, water-tight, all existing curbs on roofs that are to be removed and any of their own new through-floor or roof penetrations.

23. Supply and install all temperature controls including all related wiring and equipment, as specified.
24. In rooms where existing ceiling is not scheduled to be removed and replaced, this contractor will be responsible for removal and replacement of ceiling tile as required to perform their work.
25. Provide and locate all access doors to architectural trades for setting as required for access to mechanical equipment.
26. Provide and locate all roof curbs or penetrations for mechanical equipment. Contractor will level all curbs, as specified. If roof curbs are not onsite at the time the roof is being installed, this contractor will be responsible for any additional charges incurred by the roofing contractor to flash in said units.
27. Contractor shall include all piping/pumps necessary to facilitate condensation removal at the cooling units. When not shown, contractor is responsible to route to nearest drain source.
28. This contractor will be responsible for cutting and patching of roof membrane as required to set or install new mechanical equipment. This work is to be performed by a manufacturer approved roofing contractor. Roof patching must not void any new or existing roof warranties.
29. Ceiling removal & replacement not shown but is required for work identified by this category will be the responsibility of this contractor.
30. This contractor is responsible for all sheet metal work, piping, and mechanical equipment required for the complete heating and cooling systems including but not limited to: AHU's, chiller, EF's, grilles, diffusers, pumps, valves, and unit heaters.
31. Furnish and install all mechanical, plumbing, sanitary, water, temperature controls, fixtures, heating/cooling, mechanical insulation, HVAC, etc systems and all mechanical demolition/repair/replacement/rough-in as detailed or specified, include legal disposal of equipment and piping removed by this contractor.
32. Pressure test all underground pipes as required in the specifications and plumbing codes.
33. This contractor is responsible for all new work on existing systems; removal and relocation of existing fixtures, equipment, and mechanical lines; and to tie-in all new mechanical work with the existing systems, as shown and required. This contractor is responsible for protection of all existing mechanical equipment and systems to remain.
34. This contractor shall include all demolition required to facilitate new and/or existing mechanical/ plumbing work. Include patching to match adjacent surfaces. The following are examples that could, but shall not be considered a complete scope of demolition, patching, matching and/or replacement of existing finishes, however required to facilitate new or existing mechanical/plumbing work:
 - a. Concrete Removal and Replacement
 - b. Masonry Removal and Replacement
 - c. Drywall Removal and Replacement
 - d. Ceiling Removal and Replacement
 - e. Floor Removal and Replacement
 - f. Floor Finishes, i.e.; Carpet, VCT, Terrazzo
35. This contractor will be required to direct all related trades as to locations and sizes of penetrations to surfaces. If proper coordination is not provided it will be the responsibility of this contractor to cut, patch and revise all holes and penetrations for the installation of all pipe and ductwork. All penetrations through

walls, floors, and ceilings will be fire and smoke stopped so as to comply with the Office of Fire Safety requirements.

36. This contractor is responsible for cutting any required openings in the metal deck as required for their. Openings shall be kept protected and water-tight.
37. Prior to final acceptance this contractor shall clean all floor drains and associated piping and remove all dirt and debris. Test with running water for good draining after cleaning.
38. Provide protection of equipment. Costs incurred due to damage of equipment because of lack of adequate protection will be the responsibility of this contractor. This includes temporarily capping all floor drains and pipes so as to prevent concrete and other construction debris from entering the plumbing.
39. Coordinate layout and installation of all mechanical piping and ductwork with other trades. This contractor is responsible for the proper location and sizes of all mechanical openings by other trades. Any corrective work necessary to wall or floor openings will be the responsibility of this contractor.
40. This contractor shall field verify all dimensions and furnish dimensional layout drawings.
41. This contractor shall include the new louvers, wall sleeves, wall boxes, splitter plates, seals, sills, blocking, backing, and shims required to complete the unit ventilator installations. Modify existing piping and or wall box as shown. Blank off unused section of louver.
42. This contractor shall be responsible for layout engineering, and ongoing clean up as it pertains to this work, coordinate layout with other contractors.
43. This contractor is to furnish duct-work coordination drawings to all related trades prior to their work commencing.
44. Provide all concrete equipment pads, platforms and bases required to include extending existing for mechanical equipment and systems.
45. This contractor is responsible for the insulation of all mechanical and plumbing systems (pipes, fittings, duct, etc) as required and specified.
46. Provide roof drains as required. Coordinate installation with category 075000.
47. Provide rough-ins and final connections for all food service equipment, as required on the mechanical and food service drawings. Coordinate location of rough-ins with category 114000. Plumbing exposed in the kitchen is to be stainless steel or chrome plated. Install all accessories supplied by category 114000 at the connections, including but not limited to: unions, gas hoses, pressure regulators, vacuum breakers, water filters, faucets, waste valves, swirl sprays, solenoid valves, and garbage disposals.
48. All exposed pipes must have a sheet metal enclosure that are preassembled and be pre-painted by Mechanical contractor. Field touch up paint by Mechanical contractor. Color to be selected by Architect.
49. This contractor is responsible for all caulking, gaskets, and sealing of mechanical and plumbing systems to provide air, water, and weather tight connections including but not limited to sealing of wall and floor penetrations and plumbing fixtures.
50. Furnish and install all supports for this contractor's equipment.
51. This contractor is to verify and stake locations of all underground utilities before beginning their work.
52. Receive duct smoke detectors from the Electrical contractor and install. Coordinate location with the Electrical contractor.

53. This contractor will be responsible for all mechanical demolition as shown on drawings. This is to include all pipe, insulation, sheet-metal, mechanical units, etc.
54. Each contractor performing demolition shall be responsible for protecting new and existing construction from damage due to their own work. If any adjacent surfaces are damaged, it will be the sole responsibility of the contractor at fault to completely repair and replace all damaged construction to the satisfaction of the Owner, Construction Manager, and Architect.
55. This contractor is responsible for the cutting and patching of all existing materials for the installation of all mechanical work. All penetrations through walls and ceilings will be fire and smoke stopped where as to comply with the State Fire Safety Requirements. Provide and install all firestopping materials. Contractor shall restore all surfaces to match existing conditions. This shall include all drywall, masonry, concrete, acoustical ceiling, steel, roofing, windows, insulated wall panels, plaster, flooring (all types), painting, and caulking work.
56. Provide complete testing, adjusting, and balancing of the mechanical systems, as specified. Provide additional testing at 90 days after completing the TAB, and during near-peak summer and winter conditions.
57. The contractor's field superintendent shall be present during testing and field reviews conducted by the various inspection agencies, including the commissioning agent and all Fire Marshall inspections.
58. Chlorinating and testing of this contractor's work, provide test reports prior to building occupancy.
59. Where drawings indicate that an existing piece of kitchen equipment is to be removed and reinstalled; this contractor shall disconnect and reconnect all mechanical utilities including but not limited to plumbing, HVAC, control wiring, etc.
60. The first floor sub-grade will be placed and compacted prior to the start of the underground work designated in this package. This contractor is responsible to excavate, install work and replace all fill to the specified density material within the building interior to the same condition it was prior to starting excavation for underground.
61. Provide shoring of any piping and/or ductwork.
62. This contractor is responsible for covering and securing, water-tight, all existing curbs on roofs that are to be removed and any of their own new through-floor or roof penetrations.
63. In rooms where existing ceiling is not scheduled to be removed and replaced, this contractor will be responsible for removal and replacement of ceiling tile as required to perform their work, as well as any cost associated with replacing with new tiles.
64. Secure, pay for, and provide all testing, inspections as required for beneficial occupancy by the Owner.
65. Provide all wiring and hookups to connect all parts, controls, fire safety devices and associated equipment necessary for complete and operational systems. Provide coordination with electrical contractor as required to interface with work described within this package.
66. Any fire protection/fire alarm/other utilities, remove and replace in order to perform own work. Have appropriate contractor reinstall lines.
67. Provide all supports required to attach to structure systems including rail supports and bracing.
68. Furnish to category 030000 or 040000 all inserts to be installed in concrete along with approved shop drawings for locations.

69. This contractor will be responsible for conformance to all national and local codes, regulations, testing and inspection requirements for beneficial occupancy by Owner.
70. Should there be discrepancies between what is shown or specified and what is required by State or local authorities, this contractor shall bring such discrepancies to the Architect's attention through Barton Malow in written form prior to bid.
71. Provide daily clean-up, according to Barton Malow standards, including daily removal of all materials and debris related to this category. If daily clean-up is not performed, the Construction Manager will provide his labor to complete the clean-up and the appropriate contractor will be back-charged.
72. Include final cleaning of all fixtures and equipment furnished by this bid category.
73. Coordination with other trades, including mandatory participation in job meetings.
74. Furnish and install fall protection tie off points or warning lines for employees and subcontractors of this bid category working above 6 foot or on roofs.
75. Fully coordinate and obtain all required approvals from governing authorities and pay for all fees and permits required as part of this contractor's work. This contractor will be responsible for scheduling all health department inspections necessary under this scope of work with Macomb County. Schedule and demonstrate to the state mechanical, plumbing and electrical inspectors that the kitchen equipment is operating properly. This contractor will have their site foreman accompany the inspectors during all scheduled inspections.
76. This contractor is solely responsible for the proper and complete operation of the equipment to be furnished and installed. Include all components necessary for proper installation if components are not shown, but required.
77. Provide all required escutcheons, pedestals, etc. for finish trim for this scope of work, as specified.
78. Supply all materials according to the construction schedule. Any necessary storage of material due to the phased nature of the construction is this contractor's responsibility.
79. Include all temporary heat in base bid based upon the schedule.
80. Correct findings from balancing reports within three days of receipt of reports. This contractor is responsible for repeat visits by the balancing contractor resulting from incomplete systems. Provide all necessary sheaves and belts to accomplish design for all new equipment.
81. Furnish and install new stainless steel wall caps as shown.
82. This contractor is to provide final hook-up of Owner supplied equipment.
83. Include all steel framing required to accommodate new mechanical units.
84. All extras must be submitted within 60 days, or cost will be voided.

EXCLUDED FROM THIS CONTRACTOR'S WORK IS:

1. None

SPECIAL CONSIDERATIONS:

1. All demolition work is assigned to the individual contractors that are responsible for the particular material or work in question. The contractor is to perform all demolition of the materials assigned in the specification sections listed in their own Description of Work, unless otherwise noted.
2. No deliveries will be accepted in or out of the construction site during the hours of 7:00pm – 7:00am.
3. Provide adequate supervision of your sub-contractors and your field personnel. This includes a field superintendent responsible for all work with the ability to make decisions.
4. All work under this scope shall comply with proper trade jurisdictions, even if it is necessary to assemble composite crews or subcontract to appropriate trades.
5. Every contractor performing Demolition of any type must provide a person who is trained and certified in lead renovation. This “certified lead renovator” must be on site at all when demolition work is occurring. The contractor must also meet all new OSHA, MOSHA, and DEQ requirements regarding lead. Contractors will be required to supply their firm’s name and copy of the certifications of the “Certified Lead Renovator” card as well as a copy of their firm’s certifications as a startup document. All other photo documentation requirements as required under the regulation will be required to be provided during the “closeout” phase of construction (as well as a copy maintained by the contractors for 3 years after date of substantial completion). The contractors will be required to post a notification packet in the buildings notifying all occupants of the upcoming renovations. Please visit the EPA’s website www.EPA.gov/lead for more information.
6. All contractors are to field verify all existing conditions prior to submitting a bid. Submitting a bid is acceptance of all field conditions. Do NOT scale the drawings. All dimensions must be verified in the field.
7. Provide photo identification badges to be worn by Contractor’s field personnel at all times. This contractor will be responsible for all re-mobilization costs for all phases of work.
8. Contractor is responsible to furnish all Barton Malow Co. start-up documents electronically and sworn affidavits within two (2) weeks of contract award. This includes signed contract, bonds, certificate of insurance, shop drawings and submittals
9. **This contractor is responsible to create a safety binder which will include the following information: site specific safety program, signed safety agreement (01600), MSDS sheets, Asbestos Training Certificates, CPR/first aid certificates, Lift certifications, Lead Renovators Certificates, Storm Water Certificates, Equipment Maintenance Logs, Equipment Training Letters, Roof Work Permits, & Letter indicating competent person. This information will be organized and clearly marked with the contractors name, address and division on the exterior of a 3 ring binder for each building you will be working at, include this safety binder as an item on your schedule of values with a value of \$1,000.00.**
10. Bidder shall complete the Bid form in its entirety, special attention is directed to the Allowances, Alternates and Unit Prices Section of the Bid Form.
11. This contractor is responsible to include all overtime and or shift time to avoid interfering with the owner operation and to meet the project schedule.

END OF BID CATEGORY 23 00 00 – MECHANICAL

BID CATEGORY 26 00 00 – ELECTRICAL

The work of this bid category includes but is not limited to providing all labor, equipment, materials, scaffolding, hoisting and incidentals to complete all the **Electrical** in accordance with the specifications, drawings and applicable codes. All work is to be performed as shown on the plans and specified in the following technical specification sections:

Specification SectionDescription of Section**DIVISION 01 – GENERAL REQUIREMENTS – ALL****DIVISION 02 – EXISTING CONDITONS**

024119

Selective Demolition

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

078413

Firestopping

079200

Joint Sealants

DIVISION 26 – ELECTRICAL – ALL**DIVISION 27 – COMMUNICATION – ALL****DIVISION 28 – ELECTRICAL SAFETY AND SECURITY - ALL**

In addition to the above, this bid category includes but is not limited to the Bidding Documents, the Bidding and Contract requirements and Division 1 General Requirements of the Project Manual and various other Technical Specifications interfacing with this work. The bidder is advised to review the work descriptions of the other categories and other referenced documents so as to not misunderstand scope responsibilities.

THE SCOPE OF THIS BID CATEGORY SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING ITEMS:

1. It is the responsibility of this Bid Category to review *all* drawings & drawing notes, including civil, architectural, structural, mechanical, and electrical drawings, and include items requiring work that is generally defined as the responsibility of this Bid Category within the work description unless otherwise noted above in the scope of work.
2. This contractor shall be responsible for receiving, off-loading, hoisting into/onto building including the safe and secure storage of materials related to this work.
3. Coordinate with other trades, including mandatory participation in job meetings.
4. Provide daily clean-up according to Barton Malow standards, including daily removal of all materials and debris related to this category. If daily clean-up is not performed, the Construction manager will provide a laborer to complete the clean-up and the appropriate contractor will be back charged.
5. This contractor will be responsible for all re-mobilization costs for all phases of work.
6. This contractor is to provide all legal disposal off-site of the debris that is a result of their work.
7. Coordinate the location and sizes of all openings with the appropriate trades.
8. This contractor shall be responsible for layout engineering, and ongoing clean up as it pertains to this work, coordinate layout with other contractors.

9. Before sawcutting or making any cuts in the floor, all contractors must use ground penetrating radar, and must provide proof that it was used, to the Barton Malow site superintendent.
10. In all locations where this contractor sawcuts the floor, this same contractor is also responsible for pouring back concrete. This contractor must coordinate with flooring contractor as to provide proper floor finish and height.
11. Any ceilings accessed are this contractor's responsibility to remove and reinstall. Coordinate above ceiling work with mechanical and architectural trades.
12. This contractor shall be responsible for receiving, off loading, hoisting into/onto building including the safe and secure storage of materials related to this work.
13. For the duration of your work, all building systems must remain operational and there shall be no interruption to the owner's systems while they are occupying the building unless previously instructed by BMC. Coordinate and schedule shut-downs as required for this contractors work during off-hours.
14. Obtain approvals, permits and coordinate the inspection and testing of the systems with state governing agencies. This contractor is responsible for and shall coordinate all work with public utility companies, as required. Pay for all fees and testing charges for each system. The contractor's field superintendent shall be present during testing and field reviews conducted by the various inspection agencies.
15. This contractor is responsible for all testing of electrical systems, sound systems, and fire alarm system upon completion of the installation.
16. This contractor will provide all temporary lighting and power per code and to meet minimum OSHA and **BMC requirements.**
17. Provide and maintain all necessary barricades, safety and warning devices until work is safe and complete.
18. Include a \$3,000 allowance for dumpsters in base bid.
19. All wiring/wiring paths to be per this contract. Verify all cable runs to be within specified distance.
20. Provide blank covers for data receptacles not used.
21. Rough-ins and final electrical connections for mechanical and electrical equipment, specialties, and casework, as specified. Coordinate with other trades to provide all required electrical connections. Furnish and install all electrical equipment and accessories as related to other trades.
22. The first floor sub-grade will be placed and compacted prior to the start of the underground work designated in this package. This contractor is responsible for all layout, excavation, backfilling, and compaction for any underground or underfloor electrical work required. Replace all fill to the specified density following excavation for the work of this category.
23. Contractor is responsible for removal all spoils resulting from their work from the site.
24. Verify and stake locations of all underground utilities before work begins.
25. Coordinate with Architect/Engineer before penetrating any structural members.
26. Provide proper identification of panels, circuits and systems.
27. Furnish and install all specified backing and supports for fixtures and equipment.

28. This contractor will provide all conduit, wiring, panels, devices, switches and accessories necessary for the installation of a complete power system.
29. Provide all required escutcheons, pedestals, etc. for finish trim for this scope of work, as specified.
30. Provide and locate all access doors to architectural trades for setting as required for access to electrical equipment.
31. This contractor is to wire all motors, disconnect switches, and starters supplied by either themselves or category 230000.
32. Furnish all pipe and conduit sleeves with bushings at each end and provide and install fire stopping for all penetrations through rated walls created by or for electrical systems.
33. Provide and install all conduits, raceways, and boxes for telephone and computer (data) system. This contractor must coordinate with the Owner's representative as to size and type of equipment.
34. Furnish, install and maintain all weather protection as required to carry out the scope of work
35. Provide and install complete fire alarm system as described in the technical specifications, supporting phasing of the project, shown on the drawings, and required to meet applicable codes and regulations. Coordinate all fire alarm work with mechanical contractor's work to provide all required safety and emergency shut down features.
36. This contractor will be responsible to provide and install smoke detectors to the building fire detection system and electrical service.
37. This contractor is responsible for and shall coordinate all work with public utility companies, as required. Pay for all fees and testing charges for each system. Follow up with fire alarm contractor to insure drawings are sent to the state as soon as possible for review. New fire alarm devices must be installed, tested & inspected and operational prior to school.
38. Provide duct mounted smoke detectors to category 230000 for installation. This contractor will be responsible to connect smoke detectors to the buildings fire detection system and electrical service.
39. Provide all equipment pads required for electrical equipment shown or not shown but required for a complete installation.
40. This contractor is responsible for the cutting and patching of all existing materials for the installation of all electrical work. All penetrations through walls and ceilings will be fire and smoke stopped where as to comply with the State Fire Safety Requirements. Provide and install all firestopping materials. Contractor shall restore all surfaces to match existing conditions. This shall include all drywall, masonry, concrete, acoustical ceilings, steel, windows, insulated wall panels, plaster, painting, and caulking work.
41. Provide and install all clocks, integrated intercom/telecommunications, sound system, and connections to projection system equipment as shown and specified, including all related materials.
42. Provide protection of equipment. Damage to equipment due to a lack of adequate protection will be the responsibility of this contractor.
43. Provide complete lighting system with occupancy and/or automated lighting controls, as required.
44. This contractor will be responsible for all electrical demolition as shown on drawings. This is to include all conduit, wiring, light fixtures, etc. This contractor is responsible for all disconnects for their own demolition as well as disconnects of the existing mechanical and kitchen equipment.

45. Each contractor performing demolition shall be responsible for protecting new and existing construction from damage due to their own work. If any adjacent surfaces are damaged, it will be the sole responsibility of the contractor at fault to completely repair and replace all damaged construction to the satisfaction of the Owner, Construction Manager, and Architect.
46. This contractor is responsible for the cutting and patching of all existing materials for the installation of all electrical work. All penetrations through walls and ceilings will be fire and smoke stopped where as to comply with the State Fire Safety Requirements. Provide and install all firestopping materials. Contractor shall restore all surfaces to match existing conditions. This shall include all drywall, masonry, concrete, acoustical ceilings, steel, windows, insulated wall panels, plaster, painting, and caulking work.
47. Any fire protection/fire alarm/other utilities, remove and replace in order to perform own work. Have appropriate contractor reinstall lines.
48. Where drawings call for light fixtures to remain or be re-installed in a new ceiling grid; this contractor shall either remove and safely store the fixtures for later reinstallation OR tie the fixtures up in an appropriate manner.
49. In rooms where existing ceiling is not scheduled to be removed and replaced, this contractor will be responsible for removal and replacement of ceiling as required to perform their work.
50. This contractor will furnish, upon completion of the work, as-built electronic drawings showing the installation of the work as completed and operating and maintenance manuals as described in the specifications and as required by owner.
51. It is the responsibility of this Bid Category to review all drawings & drawing notes, including civil, architectural, structural, mechanical, and electrical drawings, and include items requiring work that is generally defined as the responsibility of this Bid Category within the work description unless otherwise noted above in the scope of work.
52. This contractor is to review the scope of work for division 23 mechanical for work by this bid category. If there is any confusion on the scope of work for these related categories submit a pre-bid RFI or clarify what is and is not included on the bid proposal form. This contractor's work will interface with the work of division 23 Mechanical in areas of wiring valves alarms, flow switches, detectors, control wiring, equipment etc. This bid division must be familiar with all related electrical requirements.
53. Reference all drawings. This contractor is responsible for all demo notes and new work notes on all electrical drawings.
54. Rough-ins and final electrical connections for mechanical and electrical equipment, specialties, and casework, as specified. Coordinate with other trades to provide all required electrical connections. Furnish and install all electrical equipment and accessories as related to other trades.
55. This contractor is responsible to provide power wiring to automatic door actuator stations.
56. All extras must be submitted within 60 days, or cost will be voided.

EXCLUDED FROM THIS CONTRACTOR'S WORK IS:

1. None

SPECIAL CONSIDERATIONS:

1. All demolition work is assigned to the individual contractors that are responsible for the particular material or work in question. The contractor is to perform all demolition of the materials assigned in the specification sections listed in their own Description of Work, unless otherwise noted.
2. No deliveries will be accepted in or out of the construction site during the hours after 7:00pm and before 7:00am.
3. Provide adequate supervision of your sub-contractors and your field personnel. This includes a field superintendent responsible for all work with the ability to make decisions.
4. Every contractor performing Demolition of any type must provide a person who is trained and certified in lead renovation. This "certified lead renovator" must be on site at all when demolition work is occurring. The contractor must also meet all new OSHA, MOSHA, and DEQ requirements regarding lead. Contractors will be required to supply their firm's name and copy of the certifications of the "Certified Lead Renovator" card as well as a copy of their firm's certifications as a startup document. All other photo documentation requirements as required under the regulation will be required to be provided during the "closeout" phase of construction (as well as a copy maintained by the contractors for 3 years after date of substantial completion). The contractors will be required to post a notification packet in the buildings notifying all occupants of the upcoming renovations. Please visit the EPA's website www.EPA.gov/lead for more information.
5. All contractors are to field verify all existing conditions prior to submitting a bid. Submitting a bid is acceptance of all field conditions. Do NOT scale the drawings. All dimensions must be verified in the field.
6. Provide photo identification badges to be worn by Contractor's field personnel at all times. This contractor will be responsible for all re-mobilization costs for all phases of work.
7. Contractor is responsible to furnish all Barton Malow Co. start-up documents electronically and sworn affidavits within two (2) weeks of contract award. This includes signed contract, bonds, certificate of insurance, shop drawings and submittals
8. **This contractor is responsible to create a safety binder which will include the following information: site specific safety program, signed safety agreement (01600), MSDS sheets, Asbestos Training Certificates, CPR/first aid certificates, Lift certifications, Lead Renovators Certificates, Storm Water Certificates, Equipment Maintenance Logs, Equipment Training Letters, Roof Work Permits, & Letter indicating competent person. This information will be organized and clearly marked with the contractors name, address and division on the exterior of a 3 ring binder for each building you will be working at, include this safety binder as an item on your schedule of values with a value of \$1,000.00.**
9. Bidder shall complete the Bid form in its entirety, special attention is directed to the Allowances, Alternates and Unit Prices Section of the Bid Form.
10. This contractor is responsible to include all overtime and or shift time to avoid interfering with the owner operation and to meet the project schedule.
11. The electrical contractor is to use AudioSentry for the security and National Time for the fire alarm portion of their work.

END OF BID CATEGORY 26 00 00 – ELECTRICAL

SECTION 00230 SCHEDULE AND PHASING

1. GENERAL

1.1. MILESTONE SCHEDULE

- 1.1.1. The following are the milestone schedule dates for the listed Work and will become a part of the Contract Documents. The master construction schedule will be developed after award of the Agreement with Contractor input.

Building	Milestone Activity	Scheduled Start	Scheduled Completion
Larson Office renovation	Demo to begin	March 31, 2017	July 31, 2017
IAE storage room	Construct new wall	March 31, 2017	June 30, 2017
Interior Door Replacements	Delivery of frames	May 15, 2017	July 28, 2017

- 1.1.2. It is expressly agreed that time is of the essence for the completion of Work under the Agreement and Contractor agrees to perform the Work within the allotted time and in the manner specified. Contractor shall be liable for any and all damages and expenses suffered by the Owner or CM arising or resulting from the failure of Contractor to perform the Work in accordance with the construction schedule.

1.2. CONSTRUCTION SCHEDULE DEVELOPMENT PROCESS

- 1.2.1. Contractor agrees to commence Work in the field within five (5) Days after being notified to do so by the CM. Contractor shall diligently perform and fully complete all Work to the satisfaction of CM and Owner.
- 1.2.2. Work shall begin at such points as CM may designate and shall be carried to completion with the utmost speed.
- 1.3.2. Contractor shall submit to CM within fifteen (15) Days of award of the Agreement all necessary scheduling information, in form and substance satisfactory to CM of all activities contained in the Contractor's scope of Work, including activity descriptions and durations in working days, for shop drawings, fabrication, delivery and installation of products, materials and equipment. This schedule shall identify precedent relationships between Contractor's activities and those of other contractors, the dollar value, necessary manpower loadings, and precedent activities for other contractors. The activities on the schedule must be at a level of detail approved by CM and should agree with the terminology and building sequencing established by CM. CM will compile all Contractors' schedules and develop a project master construction schedule. Once the individual contractors schedules are agreed upon by CM, this project master construction schedule will become the project plan for construction.
- 1.3.3. Special requirements and/or sequencing issues should be brought to the attention of CM. It is intended the milestones remain in effect and all Bidders agree to accept the milestone dates. CM reserves the right to revise the project master construction schedule as deemed necessary.
- 1.3.4. CM shall periodically update the project master construction schedule and display it at the Project site. Contractor shall familiarize itself with the project master construction schedule and how it will affect or modify its operations, including coordination with the activities of other contractors. Reasonable changes in sequencing, durations and phasing are to be expected with each master schedule update. These changes will be made by Contractor at no additional cost. Reasonable changes in sequencing, durations, and phasing are to be expected with each master schedule update. These changes will be made by Contractor at no additional cost.
- 1.3.5. If it is apparent Contractor is unable to perform its Work in the sequence indicated or the time allotted, Contractor must notify CM within five (5) Days after initial publication of the project master construction schedule. Contractor's schedule of activities may be re-sequenced, and the

schedule may be adjusted, provided all Work is completed within the stated milestone dates and provided CM and affected contractors are notified of the change within five (5) calendar days of receipt of the schedule and the change does not otherwise negatively impact the other scheduled work; otherwise, the project master construction schedule shall be deemed accepted by all parties and becomes a contractual requirement for each Contractor.

- 1.3.6. If Contractor delays progress for any reason other than those delays specifically excused under the Contract Documents, Contractor will take all necessary steps to expedite its Work to maintain milestone target dates at no expense or additional cost to Owner or CM.
- 1.3.7. If Contractor is behind schedule and is so notified by CM, Contractor shall be required to accelerate the Work at its own expense. Contractor shall furnish to CM a short interval schedule of its Work showing location, number of men and crew required to get back on the agreed upon master construction schedule. If Contractor fails to maintain and meet the short interval schedule, Owner through CM reserves the right to take whatever steps it deems necessary in its sole discretion to recover the schedule at the Contractor's expense. The Contractor shall employ such means as overtime work, multiple work shifts, and additional equipment, all without additional compensation, and shall continue to do so until the progress of the Work, in the opinion of CM, is in conformance with the master project construction schedule.
- 1.3.8. Contractor agrees that it shall have no claim against the Owner, Architect, or CM for an increase in the contract price or for a payment or allowance of any kind for damage, loss, or expense arising or resulting from delays, regardless of whether the delay is the basis for an extension of time. This provision includes claims for damage, loss, or expense arising or resulting from

interruptions to, or necessary suspension of, Contractor's Work to enable other contractors to perform their work.

END OF SECTION 00230

SECTION 00400
BID PROPOSAL FORM
(Submit in Triplicate - Fill in all Blanks)

DATE: _____

TO: Troy School District
1140 Rankin
Troy, MI 48083

PROJECT: Troy School District 2013 Bond Program
Series 2, Bid Package #19
Larson Office Renovation, IAE storage
room, Interior Door Replacements (various
buildings)

ATTN: Todd Hensley
Purchasing Supervisor

CM :Barton Malow Company

Architect: TMP Architecture

Name of Bidding Co.:

Contact Name:

Email Address:

Business Address:

Phone Number:

**Bid Proposal for
Category(ies):**

Bidder, in compliance with the Advertisement to Bid for construction contemplated for Bid Package No. 19: Larson Office Renovations, IAE storage room, Interior Door replacements (various buildings) having carefully examined the Bidding Documents and the site of the proposed Project and the conditions affecting the proposed Work in the Bid Category(ies) including the condition of the Project site, any surface or subsurface obstruction, the actual levels, all excavating, filling in, removal and demolition, measurements and quantities involved in the Work, the availability of labor, materials and equipment, and the weather conditions that may possibly may be experienced in the Project vicinity, proposes to furnish all labor, materials, tools, equipment, machinery, equipment rental, transportation, superintendence, and services as are necessary to perform all Work in the Bid Category(ies) stated in accordance with the Contract Documents for the Base Bid and Alternate amounts stated below.

If identified as one of the apparent lowest bidder(s) for a Bid Category Bidder agrees to meet immediately with CM and shall submit post bid information as described in Section 00200 Instructions to Bidders.

Bidder, if awarded a contract, agrees to: (1) execute the Agreement within fifteen (15) days of receiving notice of the award; (2) provide performance/payment bonds and insurance certificates in full compliance with the Contract Documents, (3) submit the Project Safety Program as described in Section 00200 Instructions to Bidders; (4) commence Work upon execution of the Agreement or at such other time as directed in the notice of award, and (5) to complete its Work in accordance with the Contract Documents and within the milestone activity dates and durations set

forth in the Bidding Documents and subsequent construction project master schedule established by CM. In the event Bidder defaults in complying with any portion of this paragraph, Bidder specifically agrees that the entire bid security amount shall become the property of Owner as liquidated damages constituting the reasonable estimate of the damages that Owner would incur for delays and additional expenses in the event of such default, and not as a penalty.

BASE BID: Bidder agrees to perform all Work for Bid Category(ies) as described in the Contract Documents, for the Base Bid(s) stated below. The Base Bid(s) shall include the cost of Performance and Payment Bonds. For each Bid Category to be bid, include the Base Bid, written and in figures, the cost of the Performance Bond and Payment Bond which is included in the Base Bid, written and in figures, and the Bid Category and description.

(Show amounts in both words and figures. In case of discrepancy, amount shown in words will govern).

BID CATEGORY	WRITTEN DESCRIPTION/AMOUNT(S)	BID AMOUNT IN FIGURES
1. Bid Category 06000 General Trades	_____	\$ _____
	_____DOLLARS	
2. Bid Category 230000 Mechanical	_____	\$ _____
	_____DOLLARS	
3. Bid Category 230000 Temperature Controls	_____	\$ _____
	_____DOLLARS	
4. Bid Category 260000 Electrical	_____	\$ _____
	_____DOLLARS	

HOURLY LABOR RATES: All contractors are required to provide their company's hourly labor rates as they apply to this project. The contract may be awarded based on this information. Failure to quote the following hourly labor rates will result in an incomplete bid proposal form and may be disqualified by Troy School District.

JOB TITLE	HOURLY RATE
	\$ _____
PROJECT MANUAL	00400-2
SECTION 00400 – Bid Proposal Form	ISSUE DATE: October 28, 2016

_____	\$ _____
_____	\$ _____
_____	\$ _____

UNIT PRICES: The following Unit Prices to Base Bid Categories are required to be offered by the respective Bidders. Bidder agrees that the following amounts will be used in determining contract changes from the Base Bid for authorized Changes in the Work. Bidder shall not include these unit costs in the Base Bid amount(s). All unit prices shall include Bidder's mark-up for overhead and profit.

BID CATEGORY CODE	DESCRIPTION OF UNIT PRICE	UNIT PRICE	
		ADD	DEDUCT
1. _____	_____	\$ _____	\$ _____
2. _____	_____	\$ _____	\$ _____
3. _____	_____	\$ _____	\$ _____

ALTERNATES: The following Alternate(s) to Base Bid(s) are required to be offered by the respective Bidders. In the event the Alternate is accepted, Bidder agrees to perform all Work necessary to complete the Work as modified by the Alternate in full accordance with the Contract Documents, for the following add or deduct from the Base Bid as indicated: (Show amount(s) in both words and figures for Alternates. In case of discrepancy, amount shown in words will govern. Enter a dollar amount in each, even if the amount is \$0.00. Terminology such as "No Bid", "Not Applicable", "No Change" or "Does Not Apply", shall not be used. If the Alternate does not apply to the Bidder, enter \$0.00.)

Alternate A1 – Larson Middle School: Quote add in price to remove and replace wall, doors and frames as indicated in drawings A0.1B and A1.1B Alt and specifications.

Add	_____	(\$ _____)
Deduct	_____	(\$ _____)

Alternate No. A2 Larson Middle School: Quote add in price to remove and replace doors B100A and B101A as indicated on drawings and specifications.

Add	_____	(\$ _____)
Deduct	_____	(\$ _____)

VOLUNTARY ALTERNATES: The following voluntary Alternates are offered by the Bidder. Bidder agrees that the amounts indicated below shall be added to or deducted from the Base Bid, as indicated, for each voluntary Alternate that is accepted. (Show amount(s) in both words and figures for voluntary alternates. In case of discrepancy, amount shown in words will govern).

BID CATEGORY	WRITTEN DESCRIPTION OF VOLUNTARY ALTERNATE AMOUNT(S)	ADD	DEDUCT
1. _____	_____	\$ _____	\$ _____

For the amount of: _____

_____ DOLLARS

Bidder is required to submit sufficient detailed information to fully describe each voluntary Alternate(s) on a separate sheet(s) attached to this Bid Proposal form.

All applicable taxes and bond costs are included in the above Base Bid and all listed Alternates and Unit Prices.

Bid Security in the form of a bid bond from a qualified surety (), certified check (), or cashier's check (), (check one) accompanies this proposal in the amount of five (5) percent of the Base Bid amount(s). Bidder agrees that this Bid Proposal shall be irrevocable for a period of 90 Days after the day and time designated for receipt of the Bid Proposal in Section 00100 of the Project Manual.

As of the date of submission of the Bid Proposal, Bidder's worker's compensation Experience Modification Rate (EMR) for the state in which the Work is to be performed is _____. Bidder has attached to the Bid Proposal form the OSHA Form 200 / 200S indicating recordable incidence rates for the last calendar year per 200,000 man-hours for the following categories:

- Total Cases _____

- Lost Workday Cases _____
 - Non-fatal Cases Without Lost Workdays _____
 - Employee Hours Worked Last Year _____
 - Fatalities in the last year (if yes describe below) _____
-

Has Bidder been cited by state or federal OSHA for any serious or willful violation? If yes, please describe:

Bidder understands that the Owner reserves the right to reject any or all Bid Proposals and to waive any informalities or irregularities therein.

Bidder acknowledges receipt of the following Addenda (identify no. and date of each):

If awarded a contract, Bidder's surety will be

Check

☐

I have included a fully executed and notarized copy of the familial disclosure form set forth in Section 00410 of this Project Manual with my Bid Proposal.

Bidder accepts the provisions of the Bidding and Contract Documents and certifies that this Bid Proposal is submitted in good faith and without collusion with any other person or entity submitting a Bid Proposal for the Work. If Bidder is required to be licensed in the state where the work is performed add "Bidder certifies that it meets all licensing requirements of the state in which work is to be performed, its current license number and classification are as follows:_____ Bidder hereby affixes its authorized signature(s) representing (check one):

_____ An individual doing business as

_____ A partnership

_____ A limited liability company, organized in

_____ (enter state)

_____ A corporation, organized in

_____ (enter state)

_____ Joint venture formed between _____ and

_____ (Signature from authorized representatives of each partner are required)

_____ An Agent with a Current Power of Attorney must be attached to this bid form.

Signature(s):

Title:

Title:

Legal Name of Firm:

Business Address:

Telephone Number: ()

(All interlinear marks, alterations or erasures shall be initialed by the signer of the Bid Proposal)

Telephone Number: ()
(All interlinear marks, alterations or erasures shall be initialed by the signer of the Bid Proposal)

END OF SECTION 00400

SWORN AND NOTARIZED FAMILIAL DISCLOSURE STATEMENT

FAMILIAR DISCLOSURE AFFIDAVIT

The undersigned, the owner or authorized office of the below-named contractor (the ‘Contractor’), pursuant to the familial disclosure requirement provided in Troy Schools, hereby represents and warrants that, excepts as provided below, no familial relationship exists between the owner or key employee of the Contractor, and any member of the Troy School Board or the Troy School Superintendent. A list of the School District’s Board of Education Members and its Superintendent may found at <http://www.troy.k12.mi.us>.

List any Familial Relationships:

Contractor:

Print Name of Contractor

By: _____

Its: _____

Subscribed and sworn before me, this _____

Seal:

day of _____, 20____, a Notary Public

in and for _____ County, _____

(Signature)
NOTARY PUBLIC

My Commission expires _____

CERTIFICATION OF COMPLIANCE – IRAN ECONOMIC SANCTIONS ACT

Michigan Public Act No. 517 of 2012

The undersigned, the owner, or authorized officer of the below-named Company, pursuant to the compliance certification requirement provided in Troy School District's Request For Proposal, the "RFP", hereby certifies, represents, and warrants that the Company and its officers, directors and employees, is not an "Iran Linked Business" within the meaning of the Iran Economic Sanctions Act, Michigan Public Act No. 517 of 2012 (the "Act"), and that in the event the Company is awarded a contract by Troy School District as a result of the aforementioned RFP, the Company is not and will not become an "Iran Linked Business" at any time during the course of performing any services under the contract.

The Company further acknowledges that any person who is found to have submitted a false certification is responsible for a civil penalty of not more than \$250,000.00 or two (2) times the amount of the contract or proposed contract for which the false certification was made, whichever is greater, the cost of Troy School District's investigation, and reasonable attorney fees, in addition to the fine. Moreover, any person who submitted a false certification shall be ineligible to bid on a request for proposal for three (3) years from the date the it is determined that the person has submitted the false certification.

Contractor:

Print Name of Contractor

By: _____

Its: _____

Subscribed and sworn before me, this _____

Seal:

day of _____, 20____, a Notary Public

in and for _____ County, _____

(Signature)
NOTARY PUBLIC

My Commission expires _____

SECTION 00500 AGREEMENT

1 AGREEMENT FORM

- 1.01 The form of Agreement that will be used for Work under this Bid Package shall be AIA Document 132 Standard Form of Agreement between Owner and Contractor, CMA 2009 Edition. The above Agreement Form is included immediately behind this section.

2. GENERAL CONDITIONS OF THE CONTRACT

- AIA 232 Document **General Conditions of the Contract for Construction, 2009 Edition** is bound within this Project Manual and is a part of the Contract Documents.

3. INSURANCE

- The description box on the ACORD certificate must be endorsed as follows:

For Troy School District 2013 Bond Projects: Barton Malow Company, Troy School District, are added as additional insureds on the Insured's commercial general liability policy, excess liability policy, automobile liability policy, and contractor's pollution liability policy, with respect to liabilities arising out of the operations or "work" performed by or on behalf of the Insured and in accordance with all Contractor requirements for such coverage. Coverage for the additional insureds is primary and non-contributory with any other insurance available to the additional insureds, whether such other insurance is available on a primary or excess basis. Waivers of subrogation apply in accordance with Contractor requirements.

- A sample of the Certificate of Insurance (ACORD) form at the end of this Section.
- CM Contractor Insurance Requirements for Agency Work, PRO 15.14, shall govern this Project. A copy of these Insurance Requirements is included in this Section.

4. BOND REQUIREMENTS

- **PERFORMANCE BONDS AND PAYMENT BONDS**
 - Troy School District will, require Contractor to furnish a Performance Bond and a Payment Bond, in amounts equal to the Agreement price, by a qualified surety naming both the Owner and CM as Obligees. All sureties providing bonds on this Project must be listed in the Department of Treasury's Circular 570, entitled "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" with the bond amounts less than or equal to the underwriting limitation indicated in the Circular, and/or must have an A.M. Best rating of A – VII or better. Bonds shall be duly executed by the Contractor, as principal, and by a surety that is licensed in the state in which the Work is to be performed
 - The Contractor shall deliver the required bonds to CM prior to execution of the Agreement. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder, at a minimum, shall submit evidence to the satisfaction of CM that such bonds will be furnished prior to commencement of on site Work. In no event may the Contractor commence on-site Work without the required bonds properly issued and delivered.

- Performance Bond and Payment Bond unmodified form AIA Document or A312 (1984 Edition) must be used for this Project.
- The Bidder's proposed surety must be acceptable to the Owner and CM. If, at any time, after acceptance of the Contractor's bonds, the surety fails to meet the stated criteria Contractor must, as a precondition to continuing Work and receiving further payments, replace the bonds with bonds from a surety that meets the stated criteria.
- The Performance and Payment Bond penal sums (i.e., the Agreement price) must be listed as a separate line item in the schedule of values.

- In the event of a Change Order, the penal sum of any required Performance and Payment Bonds shall be adjusted to equal the adjusted Contract Price. CM or Owner shall have the right to request submission of bond riders, issued by the original qualified surety, evidencing that such adjustments to the penal sum of the bonds have been accomplished. Notwithstanding the foregoing, in the next pay application after the Agreement price has been increased by twenty- five percent (25%) or more, as a condition precedent to payment, Contractor shall deliver a bond rider issued by the original qualified surety evidencing that the appropriate adjustment in penal sums has been accomplished.

END OF SECTION 00500

DRAFT AIA® Document A132™ – 2009

Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«New Haven Community Schools»
«30375 Clark Street
P.O. Box 482000
New Haven, MI 48048
Troy School District
4400 Livernois
Troy, MI 48098»
«Telephone Number: 248-823-4000/586-749-5123»
«Fax Number: 248-823-4013/586-248-749-6307»

and the Contractor:
(Name, legal status, address and other information)

« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«Troy School District – 2013 Bond Program
New Haven Community Schools»
« »
« »

The Construction Manager:
(Name, legal status, address and other information)

«Barton Malow Company»
«24200 F.V. Pankow Blvd.
Clinton Township, MI 48036»
« »
« »

The Architect:
(Name, legal status, address and other information)

«TMP Architecture Inc
1191 West Square Lake Road
Bloomfield Hills, MI 48302
Fanning-Howey»
«28001 Cabot»

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Documents A232™-2009, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition; A132™-2009, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™-2009, Standard Form of Agreement Between Owner and Construction Manager as Adviser.

AIA Document A232™-2009 is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

Suite 110
Novi, MI 48377»
«Telephone Number: 248-338-4561248-848-0123»
«Fax Number: 248-338-0223248-848-0133»

The Owner and Contractor agree as follows.



TABLE OF ARTICLES

1	THE CONTRACT DOCUMENTS
2	THE WORK OF THIS CONTRACT
3	DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4	CONTRACT SUM
5	PAYMENTS
6	DISPUTE RESOLUTION
7	TERMINATION OR SUSPENSION
8	MISCELLANEOUS PROVISIONS
9	ENUMERATION OF CONTRACT DOCUMENTS
10	INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than Modifications, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.

(Insert the date of commencement, if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

<< >>

If, prior to the commencement of the Work, the Owner requires time to file mortgages, mechanics' liens and other security interests, the Owner's time requirement shall be as follows:

<< >>

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than <>> (<>>) days from the date of commencement, or as follows:

(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

<< >>

Portion of the Work

Substantial Completion Date

, subject to adjustments of this Contract Time as provided in the Contract Documents.

(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

<< >>

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be one of the following:

(Check the appropriate box.)

☒ Stipulated Sum, in accordance with Section 4.2 below

☐ Cost of the Work plus the Contractor's Fee without a Guaranteed Maximum Price, in accordance with Section 4.3 below

☐ Cost of the Work plus the Contractor's Fee with a Guaranteed Maximum Price, in accordance with Section 4.4 below

(Based on the selection above, complete Section 4.2, 4.3 or 4.4 below. Based on the selection above, also complete either Section 5.1.4, 5.1.5 or 5.1.6 below.)

§ 4.2 Stipulated Sum

§ 4.2.1 The Stipulated Sum shall be (\$), subject to additions and deletions as provided in the Contract Documents.

§ 4.2.2 The Stipulated Sum is based on the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

<<

>>

§ 4.2.3 Unit prices, if any:

(Identify and state the unit price, and state the quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit (\$0.00)
------	-----------------------	-------------------------

§ 4.2.4 Allowances included in the Stipulated Sum, if any:

(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Allowance
------	-----------

~~§ 4.3 Cost of the Work Plus Contractor's Fee without a Guaranteed Maximum Price~~

~~§ 4.3.1 The Contract Sum is the Cost of the Work as defined in Exhibit A, Determination of the Cost of the Work, plus the Contractor's Fee.~~

~~§ 4.3.2 The Contractor's Fee:~~

~~(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee.)~~

«»

§ 4.3.3 The method of adjustment of the Contractor's Fee for changes in the Work:

«»

§ 4.3.4 Limitations, if any, on a Subcontractor's overhead and profit for increases in the cost of its portion of the Work:

«»

§ 4.3.5 Rental rates for Contractor-owned equipment shall not exceed « » percent (« » %) of the standard rate paid at the place of the Project.

§ 4.3.6 Unit prices, if any:
(Identify and state the unit price; state quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit (\$0.00)
------	-----------------------	-------------------------

§ 4.3.7 The Contractor shall prepare and submit to the Construction Manager for the Owner, in writing, a Control Estimate within 14 days of executing this Agreement. The Control Estimate shall include the items in Section A.1 of Exhibit A, Determination of the Cost of the Work.

§ 4.4 Cost of the Work Plus Contractor's Fee with a Guaranteed Maximum Price

§ 4.4.1 The Contract Sum is the Cost of the Work as defined in Exhibit A, Determination of the Cost of the Work, plus the Contractor's Fee.

§ 4.4.2 The Contractor's Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee.)

«»

§ 4.4.3 The method of adjustment of the Contractor's Fee for changes in the Work:

«»

§ 4.4.4 Limitations, if any, on a Subcontractor's overhead and profit for increases in the cost of its portion of the Work:

«»

§ 4.4.5 Rental rates for Contractor-owned equipment shall not exceed « » percent (« » %) of the standard rate paid at the place of the Project.

§ 4.4.6 Unit Prices, if any:
(Identify and state the unit price, and state the quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit (\$0.00)
------	-----------------------	-------------------------

§ 4.4.7 Guaranteed Maximum Price

§ 4.4.7.1 The sum of the Cost of the Work and the Contractor's Fee is guaranteed by the Contractor not to exceed « » (\$ « »), subject to additions and deductions by changes in the Work as provided in the Contract Documents. Such maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.

(Insert specific provisions if the Contractor is to participate in any savings.)

«—»

§ 4.4.7.2 The Guaranteed Maximum Price is based on the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

«—»

§ 4.4.7.3 Allowances included in the Guaranteed Maximum Price, if any:
(Identify and state the amounts of any allowances, and state whether they include labor, materials, or both.)

Item	Allowance

§ 4.4.7.4 Assumptions, if any, on which the Guaranteed Maximum Price is based:

«—»

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Construction Manager by the Contractor, and upon certification of the Project Application and Project Certificate for Payment or Application for Payment and Certificate for Payment by the Construction Manager and Architect and issuance by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

«the 15th day of each month. All rough drafts are due on or before the 10th day and Three originals, sworn statements and insurance certificates are due on or before the 15th day of each month. NO EXCEPTIONS TAKEN.»

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§ 5.1.3 Provided that an Application for Payment is received by the Construction Manager not later than the «15th» day of a month, the Owner shall make payment of the certified amount in the Application for Payment to the Contractor not later than the «5th» day of the «second» month following submission. If an Application for Payment is received by the Construction Manager after the application date fixed above, payment shall be made by the Owner not later than «Eighty» («80») days after the Construction Manager receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Progress Payments Where the Contract Sum is Based on a Stipulated Sum

§ 5.1.4.1 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work and be prepared in such form and supported by such data to substantiate its accuracy as the Construction Manager and Architect may require. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.4.2 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.4.3 Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- 1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of «Ten» percent

- («10» %). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute may be included as provided in Section 7.3.9 of the General Conditions;
- .2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of «Ten» percent («10» %);
 - .3 Subtract the aggregate of previous payments made by the Owner; and
 - .4 Subtract amounts, if any, for which the Construction Manager or Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of the General Conditions.

§ 5.1.4.4 The progress payment amount determined in accordance with Section 5.1.4.3 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to «Ninety» percent («90» %) of the Contract Sum, less such amounts as the Construction Manager recommends and the Architect determines for incomplete Work and unsettled claims; and
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of the General Conditions.

§ 5.1.4.5 Reduction or limitation of retainage, if any, shall be as follows:

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.4.3.1 and 5.1.4.3.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

«—»

§ 5.1.5 Progress Payments Where the Contract Sum is Based on the Cost of the Work without a Guaranteed Maximum Price

§ 5.1.5.1 With each Application for Payment, the Contractor shall submit the cost control information required in Exhibit A, Determination of the Cost of the Work, along with payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached and any other evidence required by the Owner, Construction Manager or Architect to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor; less (2) that portion of those payments attributable to the Contractor's Fee; plus (3) payrolls for the period covered by the present Application for Payment.

§ 5.1.5.2 Applications for Payment shall show the Cost of the Work actually incurred by the Contractor through the end of the period covered by the Application for Payment and for which the Contractor has made or intends to make actual payment prior to the next Application for Payment.

§ 5.1.5.3 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- .1 Take the Cost of the Work as described in Exhibit A, Determination of the Cost of the Work;
- .2 Add the Contractor's Fee, less retainage of « » percent (« » %). The Contractor's Fee shall be computed upon the Cost of the Work described in that Section at the rate stated in that Section; or if the Contractor's Fee is stated as a fixed sum, an amount which bears the same ratio to that fixed sum Fee as the Cost of the Work bears to a reasonable estimate of the probable Cost of the Work upon its completion;
- .3 Subtract retainage of « » percent (« » %) from that portion of the Work that the Contractor self-performs;
- .4 Subtract the aggregate of previous payments made by the Owner;
- .5 Subtract the shortfall, if any, indicated by the Contractor in the documentation required by Article 5 or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and
- .6 Subtract amounts, if any, for which the Construction Manager or Architect has withheld or withdrawn a Certificate for Payment as provided in Section 9.5 of AIA Document A232™ - 2009, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition.

~~§ 5.1.5.4 The Owner, Construction Manager and Contractor shall agree upon (1) a mutually acceptable procedure for review and approval of payments to Subcontractors and (2) the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.~~

~~§ 5.1.5.5 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and shall not be deemed to represent that the Construction Manager and Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Article 5 or other supporting data; that the Construction Manager and Architect have made exhaustive or continuous on-site inspections; or that the Construction Manager and Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.~~

~~§ 5.1.5.6 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.~~

~~§ 5.1.6 Progress Payments Where the Contract Sum is Based on the Cost of the Work with a Guaranteed Maximum Price~~

~~§ 5.1.6.1 With each Application for Payment, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner or Architect to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor; less (2) that portion of those payments attributable to the Contractor's Fee; plus (3) payrolls for the period covered by the present Application for Payment.~~

~~§ 5.1.6.2 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work and be prepared in such form and supported by such data to substantiate its accuracy as the Construction Manager and Architect may require. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.~~

~~§ 5.1.6.3 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment. The percentage of completion shall be the lesser of (1) the percentage of that portion of the Work which has actually been completed; or (2) the percentage obtained by dividing (a) the expense that has actually been incurred by the Contractor on account of that portion of the Work for which the Contractor has made or intends to make actual payment prior to the next Application for Payment by (b) the share of the Guaranteed Maximum Price allocated to that portion of the Work in the schedule of values.~~

~~§ 5.1.6.4 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:~~

- ~~1. Take that portion of the Guaranteed Maximum Price properly allocable to completed Work as determined by multiplying the percentage of completion of each portion of the Work by the share of the Guaranteed Maximum Price allocated to that portion of the Work in the schedule of values. Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.10 of AIA Document A232-2009;~~
- ~~2. Add that portion of the Guaranteed Maximum Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work, or if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing;~~
- ~~3. Add the Contractor's Fee, less retainage of « » percent (« » %). The Contractor's Fee shall be computed upon the Cost of the Work at the rate stated in Section 4.4.2 or, if the Contractor's Fee is stated as a fixed sum in that Section, shall be an amount that bears the same ratio to that fixed sum fee as the Cost of the Work bears to a reasonable estimate of the probable Cost of the Work upon its completion;~~
- ~~4. Subtract retainage of « » percent (« » %) from that portion of the Work that the Contractor self-performs;~~
- ~~5. Subtract the aggregate of previous payments made by the Owner;~~

- ~~.6 Subtract the shortfall, if any, indicated by the Contractor in the documentation required by Section 5.1.6.1 to substantiate prior Applications for Payment, or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and~~
- ~~.7 Subtract amounts, if any, for which the Construction Manager or Architect have withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A232-2009.~~

~~§ 5.1.6.5 The Owner and the Contractor shall agree upon a (1) mutually acceptable procedure for review and approval of payments to Subcontractors and (2) the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.~~

~~§ 5.1.6.6 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and shall not be deemed to represent that the Construction Manager or Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Section 5.1.6.1 or other supporting data; that the Construction Manager or Architect have made exhaustive or continuous on-site inspections; or that the Construction Manager or Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.~~

~~§ 5.1.6.7 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.~~

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- ~~.1~~ the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2 of AIA Document A232-2009, and to satisfy other requirements, if any, which extend beyond final payment;
- ~~.2~~ the Contractor has submitted a final accounting for the Cost of the Work, pursuant to Exhibit A, Determination of the Cost of the Work when payment is on the basis of the Cost of the Work, with or without a Guaranteed Maximum payment; and
- ~~.32~~ a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect; such final payment shall be made by the Owner not more than 30 days after the issuance of the final Certificate for Payment or Project Certificate for Payment, or as follows:

«Per Manual »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A232-2009, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

<< »
<< »
<< »
<< »

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A232-2009, the method of binding dispute resolution shall be as follows:

(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

[« »] Arbitration pursuant to Section 15.4 of AIA Document A232-2009.

[☒] Litigation in a court of competent jurisdiction.

[☐] Other: (Specify)

« »

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 Where the Contract Sum is a Stipulated Sum

§ 7.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2009.

§ 7.1.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2009.

§ 7.2 Where the Contract Sum is Based on the Cost of the Work with or without a Guaranteed Maximum Price

§ 7.2.1 Subject to the provisions of Section 7.2.2 below, the Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2009.

§ 7.2.2 The Contract may be terminated by the Owner for cause as provided in Article 14 of AIA Document A232–2009; however, the Owner shall then only pay the Contractor an amount calculated as follows:

1. Take the Cost of the Work incurred by the Contractor to the date of termination;
2. Add the Contractor's Fee computed upon the Cost of the Work to the date of termination at the rate stated in Sections 4.3.2 or 4.4.2, as applicable, or, if the Contractor's Fee is stated as a fixed sum, an amount that bears the same ratio to that fixed sum Fee as the Cost of the Work at the time of termination bears to a reasonable estimate of the probable Cost of the Work upon its completion; and
3. Subtract the aggregate of previous payments made by the Owner.

§ 7.2.3 If the Owner terminates the Contract for cause when the Contract Sum is based on the Cost of the Work with a Guaranteed Maximum Price, and as provided in Article 14 of AIA Document A232–2009, the amount, if any, to be paid to the Contractor under Section 14.2.4 of AIA Document A232–2009 shall not cause the Guaranteed Maximum Price to be exceeded, nor shall it exceed the amount calculated in Section 7.2.2.

§ 7.2.4 The Owner shall also pay the Contractor fair compensation, either by purchase or rental at the election of the Owner, for any equipment owned by the Contractor that the Owner elects to retain and that is not otherwise included in the Cost of the Work under Section 7.2.1. To the extent that the Owner elects to take legal assignment of subcontracts and purchase orders (including rental agreements), the Contractor shall, as a condition of receiving the payments referred to in this Article 7, execute and deliver all such papers and take all such steps, including the legal assignment of such subcontracts and other contractual rights of the Contractor, as the Owner may require for the purpose of fully vesting in the Owner the rights and benefits of the Contractor under such subcontracts or purchase orders.

§ 7.2.5 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2009; in such case, the Contract Sum and Contract Time shall be increased as provided in Section 14.3.2 of AIA Document A232–2009, except that the term "profit" shall be understood to mean the Contractor's Fee as described in Sections 4.3.2 and 4.4.2 of this Agreement.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A232–2009 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

« 0 » % «Zero »

§ 8.3 The Owner's representative:

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User Notes:

(1748318584)

(Name, address and other information)

«Ken Miller
1140 Rankin Dr.
Troy, MI 48083 »
«30375 Clark Street
P.O. Box 482000
New Haven, MI 48048»

« »

« »

« »

« »

§ 8.4 The Contractor's representative:
(Name, address and other information)

« »

« »

« »

« »

« »

« »

§ 8.5 Neither the Owner's nor the Contractor's representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

««NONE»»

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A132–2009, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition.

§ 9.1.2 The General Conditions are, AIA Document A232–2009, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
Refer to Attachment «A»			

§ 9.1.4 The Specifications:
(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

« »

Section	Title	Date	Pages
Refer to Attachment «A»			

§ 9.1.5 The Drawings:
(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

« »

Number	Title	Date
Refer to Attachment "A"		

§ 9.1.6 The Addenda, if any:

Number	Date	Pages
Refer to Attachment "A"		

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents are:

- ~~1. AIA Document A132™–2009, Exhibit A, Determination of the Cost of the Work, if applicable.~~
- ~~2. AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed, or the following:~~

« »

- ~~3. AIA Document E202™–2008, Building Information Modeling Protocol Exhibit, if completed, or the following:~~

« »

- 41 Other documents, if any, listed below:

(List here any additional documents which are intended to form part of the Contract Documents. AIA Document A232–2009 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

«Post Bid Review dated:
Attachment "A" dated: »

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A232–2009.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A232–2009.)

Type of Insurance or Bond	Limit of Liability or Bond Amount (\$0.00)
Refer to Project Manual	

This Agreement is entered into as of the day and year first written above.

OWNER (Signature)

CONTRACTOR (Signature)

« »

(Printed name and title)

« »

(Printed name and title)

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**BARTON MALOW COMPANY
CONTRACTOR
INSURANCE REQUIREMENTS**
For agency work
March 10, 2008

1. As a condition of performing work under the Agreement, Contractor will keep in force, at all times during performance of the Work, policies of insurance covering all Basic Insurance Requirements and any applicable Supplemental Insurance Requirements. The requirements identified below are minimum requirements. If the Agreement or other Contract Documents impose additional or higher standards, Contractor shall meet those as well. Where a Controlled Insurance Program ("CIP") is specified in the Contract Documents, these insurance requirements shall not apply to coverages supplied by the CIP, but shall apply to coverages which Contractor is required to carry outside the scope of the CIP.

2. **Basic Insurance Requirements**

- 2.1. Workers' Compensation covering Contractor's statutory obligations in the State(s) in which the Work is to be performed or Federal statutory obligations, if applicable to the Project, and Employers' Liability insurance with limits of liability of \$1,000,000 EL Each Accident, EL Disease – Each Employee, and EL Disease – Policy Limit. Where applicable, a US Longshore and Harborworker's Compensation Act endorsement must be included.
- 2.1.1. If Contractor employs the services of leased employees for the Work or for a portion of the Work, it will be required to submit evidence, to the satisfaction of Barton Malow Company, that such leased employees are fully covered by the minimum limits of Workers' Compensation and Employers' Liability Insurance. Such evidence shall include, but not be limited to, submission of the applicable leasing agreement.
- 2.2. Automobile Liability insurance with the limit of \$1,000,000 per accident covering Contractor's owned, non-owned and hired automobiles.
- 2.3. Commercial General Liability insurance written on the 1988 ISO OCCURRENCE policy form or subsequent versions with limits of liability as follows:
- | | |
|---|--------------|
| General Aggregate | \$ 2,000,000 |
| Products-Completed Operations Aggregate | \$ 2,000,000 |
| Personal/Advertising Injury | \$ 2,000,000 |
| Each Occurrence | \$ 2,000,000 |

This coverage shall include coverage for premises-operations, independent contractors' protective, products and completed operations, personal injury and broad form property damage (including coverage for explosion, collapse, and underground hazards), and Contractual Liability protection with respect to Contractor's indemnification obligations under the Contract Documents. Products-completed operations coverage must be maintained for at least two years after final completion of the Project.

3. **Supplemental Insurance Requirements**

- 3.1. Watercraft Protection and Indemnity Liability insurance if any of the Work is on or over navigable waterways or involves use of any vessel. Limits are to be approved by Barton Malow Company in writing.
- 3.2. Aircraft Liability insurance if any aircraft is used in performance of the Work. Limits are to be approved by Barton Malow Company in writing.
- 3.3. Railroad Protective Liability insurance if any of the Work is on or within 50 feet of any railroad or affects railroad property, including but not limited to tracks, bridges, tunnels, and switches. Limits are to be approved by Barton Malow Company in writing.
- 3.4. Professional Liability insurance, if Professional Services are provided, with limits of liability as follows:
- | | |
|------------|--------------|
| Each Claim | \$ 5,000,000 |
| Aggregate | \$ 5,000,000 |

Provided, however, that if the Subcontract Price is \$10,000,000 or less, then the following limits of liability shall apply:

Each Claim	\$ 2,000,000
Aggregate	\$ 2,000,000

Contractor shall keep such Professional Liability insurance in force during the Agreement, and for three years after final completion of the Project.

- 3.5. Pollution Liability insurance, which must be on an occurrence basis, if Environmental Services are provided. "Environmental Services" means any abatement, removal, remediation, transporting, or disposal of a Hazardous Material, or any assessments or consulting relating to same. Limits of liability for Pollution Liability insurance shall be as follows:

Each Occurrence	\$ 5,000,000
Aggregate	\$ 5,000,000

4. General Provisions

- 4.1. Every policy must be written by an insurance company licensed in the state where work is being done and is reasonably acceptable to Barton Malow Company and Owner.
- 4.2. Limits for Employer's Liability, Commercial General Liability and Automobile Liability may be attained by a combination of an underlying policy with an umbrella or excess liability policy.
- 4.3. "Barton Malow Company," Owner, and all other entities as required in the Contract Documents shall be endorsed as additional insureds on Contractor's liability insurance (including general liability, excess liability, automobile liability and pollution liability, where applicable) with respect to liability arising out of activities, "operations" or "work" performed by or on behalf of Contractor, including Barton Malow Company's general supervision of Contractor, products and completed operations of Contractor, and automobiles owned, leased, hired or borrowed by Contractor. The coverage provided by the additional insured endorsement shall be at least as broad as the Insurance Service Office, Inc.'s Additional Insured, Form B CG 20 10 11 85 or CG 20 26 11 85. Forms that do not provide additional insured status for completed operations will not be accepted. In no case shall any additional insured endorsement exclude coverage for Barton Malow Company's or Owner's own negligence nor limit coverage for Barton Malow Company or Owner only to potential liability incurred solely as a result of Barton Malow Company's or Owner's acts or omissions. Furthermore, nothing in the additional insured endorsement shall limit Barton Malow Company's or Owner's products-completed operations coverage to only those liabilities arising from Contractor's "ongoing operations".
- 4.4. Contractor will furnish, before any work is started, certificates of insurance and copies of any additional insured endorsements for Contractor's liability policies showing the required coverages. Receipt by Barton Malow Company of a non-conforming certificate of insurance without objection, or Barton Malow Company's failure to collect a certificate of insurance, shall not waive or alter Contractor's duty to comply with the insurance requirements. Modifications to these insurance requirements will not be effective unless made in a writing executed by an authorized representative of Barton Malow Company. Upon written request by Barton Malow Company, Contractor will provide copies of its insurance policies.
- 4.5. Evidence of the required insurance is to be provided to Barton Malow Company on ACORD Certificate Form 25-S and must indicate:
- 4.5.1. Any coverage exclusions or deviations from the 1988 ISO commercial general liability form or subsequent versions;
- 4.5.2. A Best's rating for each insurance carrier at A minus VII or better;
- 4.5.3. That the issuing insurance company will provide thirty (30) days written notice of cancellation to the certificate holder and the words "endeavor to" and "but failure to mail such notice shall impose no obligation or liability of any kind upon the company, its agents or representatives" do not apply or have been removed;
- 4.5.4. That additional insured endorsements have been provided as required under the Contract Documents; and
- 4.5.5. Any deductibles over \$10,000 applicable to any coverage.
- 4.6. All coverage must be primary and not excess over or contributory with any other valid, applicable, and collectible insurance or self-insurance in force for Barton Malow Company, Owner, or other additional insureds.
- 4.7. Contractor will provide full coverage for all of Contractor's equipment, property and tools used in the Work.
- 4.8. Contractor shall waive, and shall require (by endorsement or otherwise) its insurers providing the coverage required by these insurance requirements to waive, subrogation rights against Barton Malow Company, Owner, and all other additional insureds for losses and damages incurred and/or paid under the insurance policies required by these insurance requirements or other insurance applicable to Contractor or its Subordinate Parties, and will include this same requirement in contracts with its Subordinate Parties. If the policies of insurance referred to in this paragraph require an endorsement to provide for continued coverage where there is a waiver of subrogation, the owners of such policies will cause them to be so endorsed.

- 4.9. Contractor will send or fax a copy of these insurance requirements to its agent when an insurance certificate is requested to assure that the policies comply with the insurance requirements.
- 4.10. If Contractor requires its Subordinate Parties to provide additional insured endorsements in favor of Contractor, those endorsements shall be extended to Barton Malow Company, Owner and all other required additional insureds.
- 4.11. Contractor's duty to provide the insurance coverage set forth in these insurance requirements is a severable obligation from Contractor's indemnification obligations under the Contract Documents. Nothing in these insurance requirements shall be deemed to limit Contractor's liability under the Agreement.
- 4.12. If these insurance requirements are used in conjunction with a Project where an Affiliated Company of Barton Malow Company is acting as Construction Manager, Design Builder or otherwise (the "Construction Entity"), the term "Barton Malow Company" as used in these insurance requirements shall be deemed to be replaced with the name of the Construction Entity, and the additional insured requirements of Section 4.3 above shall be amended to include "Barton Malow Company", and all partners and/or members of the Construction Entity as applicable. "Affiliated Company" means any entity in which Barton Malow Company has an ownership interest.

END OF DOCUMENT PRO 15-14

SECTION 00810
ON-SITE PROJECT SAFETY AND LOSS CONTROL PROGRAM

1 SUBCONTRACTOR'S SAFETY REQUIREMENTS

1.1 Generally the Subcontractor

- 1.1.1 is responsible for its own Safety Program for Work on this Project that is at least as stringent as the requirements set forth in this section of the Project Manual.
- 1.1.2 shall provide a safe workplace and shall otherwise take all precautions for the safety of Subordinate Parties and persons and property in or near the premises where Work is being performed.
- 1.1.3 shall comply with all applicable federal, state and local laws, rules and regulations, including, but not limited to, applicable provisions of the Occupational Safety and Health Act ("OSHA") and/or the governing state law.
- 1.1.4 shall comply with all requirements stated in the Site Specific Safety Instructions (SSSI) form or elsewhere in the Contract Documents.
- 1.1.5 shall ensure that its employees understand and comply with applicable safety and health programs, rules, and regulations.
- 1.1.6 will assign an individual to act as Safety Representative who will have the responsibility of resolving safety matters, and act as a liaison among Subcontractor, CM and the Owner. The Safety Representative must be a person who is capable of identifying existing and predictable hazards in surroundings that are unsanitary, hazardous or dangerous to employees, and has the authority to take prompt corrective measures to eliminate them. The Safety Representative must meet the standards for a Competent Person under applicable law when required (scaffolding, confined spaces, etc.). The Safety Representative must be on site full time. The Safety Representative or an alternate must attend periodic safety meetings as directed by CM. The safety representative must have completed the OSHA 30 hour Construction Training Course.
- 1.1.7 shall ensure that its site supervisors and/or Safety Representative attend a pre-construction meeting where planning for safe execution of the project will be addressed.
- 1.1.8 is fully responsible for all Hazardous Materials it creates or releases in connection with, or brings to, the Project. Subcontractor shall immediately report to CM any Hazardous Materials that it discovers or which are released at the Project.
- 1.1.9 Minimum training for on-site employees shall include basic safety orientation, task-specific safety instruction, weekly Tool Box Talks, and other periodic safety meetings. Subcontractor shall document all such training.
- 1.1.10 shall self-inspect its areas of control to assure compliance with the safety requirements.
- 1.1.11 All on-site employees of either Subcontractor] or its Subordinate Parties are required to report any unsafe act or condition and any work-related injuries or illness immediately to a supervisor. If the act or condition can be safely and easily corrected, the employee or supervisor should make the correction.
- 1.1.12 shall notify CM immediately of all injuries requiring clinical attention and all property damage potentially in excess of \$1,000.
- 1.1.13 shall have emergency procedures to deal with the immediate removal and treatment, if necessary, of any employee who may be injured or become ill. Subcontractor] shall keep on the Project site a first-aid kit supplied according to current regulations, and shall have on-site a person trained to administer first aid.
- 1.1.14 shall inform CM of the arrival of any federal or state inspector or compliance officer prior to touring the site. Any reports, citations, or other documents related to the inspection shall be provided promptly to Barton Malow.

- 1.1.15 shall have a written Substance Abuse Policy. The use or possession of illegal drugs or the use of alcohol while performing Work on the Project are strictly prohibited and will lead to immediate removal from the Project.
- 1.1.16 shall be responsible for payment of all safety-related citations, fines and/or claims arising out of or relating to its Work levied against the Owner, Architect, CM, or their employees or affiliates.
- 1.1.17 CM has the right to require that Subcontractor H submit monthly its hours worked and incident rates for the Project.
- 1.2 Additional CM Requirements
 - 1.2.1 Work crews shall conduct a Job Hazard Analysis (JHA,) discussion (i.e. Huddle) to plan for safe performance before beginning any work task. Subcontractor is required to prepare a written record of each JHA.
 - 1.2.2 All workers, management, and visitors shall wear approved hard hats while on site, outside the trailers. Cowboy-style hard hats are prohibited. Hardhats must not be removed to use welding shields. Welding shields must attach to hardhats or be hand held.
 - 1.2.3 Sleeved shirts (minimum of four inches), long pants, and durable work boots are required minimum clothing.
 - 1.2.4 Personal cell phones are not to be used on construction sites except to report an emergency or on approved break time. Use of business cell phones must not interfere with jobsite safety.
 - 1.2.5 Personal radios or music players are not permitted.
 - 1.2.6 All persons working at elevations of six feet or greater must have 100% continuous fall protection. Engineering controls are preferred, but personal fall arrest systems are also permissible. An exception is permitted for safe use of ladders up to 24 feet long.
 - 1.2.7 Subcontractor is responsible to repair or restore any barricade that it modifies or removes.
 - 1.2.8 Class II III (household) stepladders are prohibited; metal ladders are strongly discouraged.
 - 1.2.9 All scaffolds must be inspected daily and before each use for safety compliance. Scaffold inspection tags must be used. Scaffolds shall never be left in an unsafe condition and must be removed/disabled immediately if not to be used again.
 - 1.2.10 All persons operating cranes must be certified as crane operators by the National Commission on the Certification of Crane Operators (NCCCO), Crane Institute Certification (CIC) or Operating Engineers Certification Program (OCEP). Daily written crane inspection reports must be prepared by the operator and kept with the crane, available for inspection.
 - 1.2.11 Riding the headache ball is prohibited.
 - 1.2.12 All dozers, loaders, tractors and end loader backhoes must have functioning backup alarms.
 - 1.2.13 Keep equipment at least 15 feet from energized power lines.
 - 1.2.14 Electrical, pneumatic, and other energy systems that could be accidentally energized or started up while work is in process must be locked out (not merely tagged out).
 - 1.2.15 Only fire retardant materials may be used to build shanties or other temporary enclosures inside of buildings finished or under construction. Shanties shall be continually policed by their occupants to prevent the accumulation of waste or other combustibles.
 - 1.2.16 Engineering controls must be used to restrain silica dust per applicable law. Dry cutting without engineering controls is prohibited.
 - 1.2.17 The Contractor is required to design and implement a Stretch and Flex program for their employees. The purpose of the program is to gently condition the muscles and tendons for the workers before they engage in their duties in order to avoid injury. All contractors of any tier shall ensure that all employees participate in stretching exercises at the beginning of the work

day. It is recommended that you consult with your insurance carrier, licensed physician or other medical personnel to develop suitable stretches for your work crew.

- 1.2.18 The Contractor is required to implement a glove program. All workers performing construction work must wear appropriate protective work gloves. When not performing work gloves must be kept available for immediate use. Cut resistant work gloves are required for any operation with sharp material or cut potential.

2 Subcontractor's SAFETY SUBMITTALS

- 2.1 Subcontractors shall provide copies of the following written safety submittals to CM at the times indicated:

Submittal	Timing
Site-specific Safety Program, including substance abuse policy, hazard communication program, and Material Safety Data Sheets (MSDS)	Before on-site work begins
Tool Box Talk Reports	Weekly
Incident Reports (OSHA form 301 or equivalent)	Within 24 hours of incident
Pre Task/Daily Reports	Daily
Stretch and Flex program	Before on-site work begins

- 2.2 Barton Malow's receipt of the Safety Program or other submittals from Subcontractor does not constitute approval of the Program or submittal or permission to deviate from the requirements of the Contract Documents and applicable law.
- 2.3 Subcontractor will allow inspection of, and CM may request copies of, any and all safety-related documents and records in its possession relating to the Project.

3 CM RIGHTS

- 3.1 **Safety Hazard Notifications** may be issued to the Subcontractor when an unsafe act or condition is reported or observed. CM shall not be required to supervise the abatement or associated reprimand of unsafe acts or conditions within a Subcontractor's scope of work as this is solely the responsibility of Subcontractor. Nevertheless, CM has the right, but not the obligation, to require Subcontractor to cease or abate any unsafe practice or activity it notices, at Subcontractor's sole expense.
- 3.2 Contractor/Subcontractor's failure to comply with the contract safety requirements will be considered a default of the Agreement, and may result in remedial action including, but not limited to, withholding of payment of any sums due or termination.
- 3.3 CM's failure to require the submission of any form, documentation, or any other act required under this Section, 00810, of the Project Manual shall not relieve the Subcontractor from any of its safety obligations.
- 3.4 Nothing in this Section or in this Agreement makes CM responsible or liable for protecting Subcontractor's employees and other Subordinate Parties or assuring or providing for their safety or preventing accidents or property damage.
- 3.5 All requirements referenced in this Section 00810 are binding on Subcontractor and all of its Subordinate Parties, even where such requirements may exceed the standards of applicable law.

END OF SECTION 00810

SECTION 00840
HAZARDOUS MATERIALS

1. DEFINITION OF HAZARDOUS MATERIALS

- 1.1. A “Hazardous Material”, as used in this Project Manual means asbestos; asbestos containing material; lead (including lead-based paint); PCB; molds; any other chemical, material, or substance subject to regulation as a hazardous material, hazardous substance, toxic substance, or otherwise, under applicable federal, state, or local law; and any other chemical, material, or substance that may have adverse effects on human health or the environment.

2. AWARENESS OF HAZARDOUS MATERIALS

- 2.1. Each Contractor shall be constantly aware of the possible discovery of Hazardous Materials. Should Contractor encounter any Hazardous Material or suspected Hazardous Material, the Contractor shall immediately stop Work in the area affected and report the condition to CM.
- 2.2. If the Contractor encounters any Hazardous Material or suspected Hazardous Material, the Contractor agrees to immediately initiate the required procedures of the Environmental Protection Agency (EPA), and/or state or local agencies having jurisdiction to protect any and all persons exposed to the affected areas or adjacent areas affected thereby
- 2.3. Contractor is fully responsible for all Hazardous Materials it creates or releases in connection with, or brings to, the Project
- 2.4. Each Contractor shall be responsible to bind ALL of its personnel and its Subordinate Parties to the provisions in the contract documents related to hazardous materials and to instruct each employee of its own duty to report any and all suspected Hazardous Materials and to comply with all applicable laws.
- 2.5. ABSOLUTELY NO MATERIAL SHALL BE BROUGHT ON OR TO THE PROJECT SITE THAT DOES NOT HAVE A MANUFACTURER'S LABEL STATING CONTENTS.
- 2.6. The Contractor shall comply with all applicable federal and state laws, rules, ordinances and regulations regarding transportation, storage, spills, releases and disposal of Hazardous Materials.
- 2.7. No asbestos or asbestos-containing material will be brought to the jobsite or incorporated into the Work by Contractor or its Subordinate Parties.

END OF SECTION 00840

SECTION 00870 LABOR RELATIONS

1. PREVAILING WAGES

- 1.1. In any Agreement entered into pursuant to this advertisement, the Contractor shall comply with the provisions of the PREVAILING WAGE LAW.
 - 1.1.1. Prevailing Wage can be found in the folder structure.
 - 1.1.2. The Contractor will pay the latest prevailing wages and fringe benefits for all Work as required by State of Michigan/Public Act 166 dated 1965 as amended. The prevailing wage and fringe benefit rates are included immediately behind this Section
- 1.2. Additionally, **Contractor** is required to comply with all other provisions of the governing prevailing wage law, and shall ensure its Subordinate Parties' compliance therewith.
- 1.3. Allegations that individuals working on this Project are not receiving compensation required by law are considered seriously by the Owner and CM. In order to expedite the resolution of prevailing wage complaints related to this Project, the Owner and CM have determined that the Michigan Fair Contracting Center ("MFCC") is the organization best equipped to expedite the investigation of these matters. Any person or entity (the "Complainant") who reasonably believes that a particular contractor, subcontractor, supplier or other person or entity providing labor, materials, goods or services on this Project (each, an "Employer") is not paying prevailing wages as required by applicable law may ask the MFCC to determine whether proper rates are being paid either by completing and submitting to MFCC a request for assistance (the "RFA") or by contacting MFCC by telephone at (734) 462-2330 or (877) 611-6322. The RFA can be downloaded electronically at <http://mifcc.org/Brochures/KnowYourRights.pdf> and delivered to MFCC by facsimile to (734) 462-2318 or by mail to P.O. Box 530492, Livonia, Michigan 48153-0492.
- 1.4. Each and every Employer who is subject to an audit by MFCC pursuant to any RFA shall cooperate and comply fully with all requests, requirements and inquiries of MFCC. If, after investigation, MFCC determines that a Complainant's allegations are meritorious and the Complainant, MFCC and the Employer are unable to resolve the dispute following MFCC's determination, then, under the direction and with the assistance of MFCC, the Complainant shall file a Prevailing Wage Complaint (the "PWC") with the State of Michigan Department of Labor and Economic Growth Wage and Hour Division (the "Wage and Hour Division"). The PWC can be downloaded electronically at <http://mifcc.org/Brochures/PrevailingWageComplaint.pdf> and delivered by facsimile to (517) 322-6352 or by mail to 7150 Harris Drive, P.O. Box 30476, Lansing, Michigan 48909-7076.
 - 1.4.1. Upon commencement of the audit from MFCC, the Owner and/or CM reserves the right to hold all payments, pending the conclusion of the audit. If the Wage and Hour Division determines that the Employer has violated any applicable prevailing wage law, then the Owner and/or Construction Manager shall automatically be entitled to and will (a) withhold from such Employer any and all payments due and owing until the Employer remedies any and all violations cited by the Wage and Hour Division, and (b) backcharge the Employer for all costs actually incurred in MFCC's audit of the Employer.
 - 1.4.2. The Owner and/or CM shall keep a hard copy of these requirements posted at the Project site at all times.
- 1.5. The Contractor shall be financially responsible for the payment of prevailing wages by all Subordinate Parties that are subject to the prevailing wage law for Work on the Project.
- 1.6. If there is a dispute between any Contractor and the unions, the Contractor will be required to meet with CM and the Union involved to try and resolve the issue.
- 1.7. Because Work on this Project is covered by the Michigan Prevailing Wage Act ("Act"), the Contractor and its subcontractors and other Subordinate Parties that are governed by the prevailing wage law shall pay all hours at the prevailing wage rates at the applicable hourly rate; no Work performed by or on

behalf of the Contractor on this Project will be paid on a lump sum basis or a piece rate basis in violation of the Act.

- 1.8. The Contractor will pay its workers at wage and fringe benefit rates consistent with the Act regardless of whether the workers are classified as employees or independent contractors.
- 1.9. The Contractor shall not misclassify any work assignments, but shall in each and every case follow proper jurisdictional assignments in compliance with the Act.
- 1.10. The Contractor shall assure that any persons paid at apprentice rates under the Act are properly classified as apprentices by actual participation in a BAT certified program or as may otherwise be permitted by the Act.

END OF SECTION 00870

State of Michigan

WHPWRequest@michigan.gov

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy Upgrades

Project Number: Bid Package 19, BID 9834

Oakland County

Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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<u>Classification</u>		Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision					
Name	Description										
=====											
Asbestos & Lead Abatement Laborer											
Asbestos & Lead Abatement Laborer	MLDC		\$41.25	\$55.00	\$68.75	H H H X X X X D Y					
4 ten hour days @ straight time allowed											
Monday-Saturday, must be consecutive											
9/16/2016											

Asbestos & Lead Abatement, Hazardous Material Handler

Asbestos and Lead Abatement, Hazardous Material Handler	AS207		\$40.75	\$54.25	\$67.75	H H H X X X X D Y
4 ten hour days @ straight time allowed						
Monday-Saturday, must be consecutive						
10/30/2015						

Boilermaker

Boilermaker	BO169		\$54.70	\$81.08	\$107.45	H H H H H H H D Y
2/17/2015						

Apprentice Rates:

1st 6 months	\$40.31	\$59.49	\$78.67
2nd 6 months	\$41.45	\$61.21	\$80.95
3rd 6 months	\$42.57	\$62.88	\$83.19
4th 6 months	\$43.69	\$64.57	\$85.43
5th 6 months	\$44.81	\$66.24	\$87.67
6th 6 months	\$48.63	\$72.50	\$96.36
7th 6 months	\$49.32	\$73.01	\$96.69
8th 6 months	\$51.58	\$76.40	\$101.21

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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Classification		Last Updated	Straight Time and Hourly	Time and Half	a Double Time	Overtime Provision				
Name	Description									
=====										
Bricklayer										
Bricklayer, stone mason, pointer, cleaner,	BR1		\$52.43	\$78.65	\$104.86	H H D H D D D D Y				
Make up day allowed comment		10/15/2014								
Saturday for 5 day 8 hour week										
Friday for 4 day 10 hour week										
4 10s allowed M-TH										

Apprentice Rates:

First 6 months	\$31.87	\$47.81	\$63.74
2nd 6 months	\$33.72	\$50.60	\$67.44
3rd 6 months	\$35.57	\$53.37	\$71.14
4th 6 months	\$37.42	\$56.14	\$74.84
5th 6 months	\$39.27	\$58.92	\$78.54
6th 6 months	\$41.12	\$61.70	\$82.24
7th 6 months	\$42.97	\$64.46	\$85.94
8th 6 months	\$44.82	\$67.24	\$89.64

Carpenter

Diver	CA 687 D		\$67.75	\$87.50	\$107.25 X X H X X H H D Y
Four 10s allowed M-Sat; double time due when over 12 hours worked per day					
<i>Make up day allowed comment</i>		8/12/2016			
Saturday					

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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Classification									
Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision			

Carpet and Resilient Floor Layer, (does not include installation of prefabricated formica & parquet flooring which is to be paid carpenter rate)	CA1045		\$51.11	\$72.33	\$93.54	X X H X X X X D Y
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7/26/2016

Apprentice Rates:

1st 6 months	\$25.41	\$34.28	\$43.14
2nd 6 months	\$29.40	\$40.26	\$51.12
3rd 6 months	\$31.57	\$43.52	\$55.46
4th 6 months	\$33.74	\$46.77	\$59.80
5th 6 months	\$35.91	\$50.03	\$64.14
6th 6 months	\$38.08	\$53.28	\$68.48
7th 6 months	\$40.25	\$56.54	\$72.82
8th 6 months	\$42.42	\$59.79	\$77.16

Carpenter four 10s allowed Mon-Sat; double time due when over 12 hours worked per day	CA687Z1		\$57.69	\$73.27	\$88.85	X X H X X H H D Y
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Make up day allowed comment
Saturdays

8/12/2016

Apprentice Rates:

1st year	\$35.37	\$43.94	\$52.51
3rd 6 months	\$37.86	\$47.21	\$56.56
4th 6 months	\$40.32	\$50.45	\$60.57
5th 6 months	\$42.81	\$53.72	\$64.62
6th 6 months	\$45.29	\$56.98	\$68.66
7th 6 months	\$47.77	\$60.24	\$72.70
8th 6 months	\$50.26	\$63.51	\$76.75

Piledriver Four 10s allowed Monday-Saturday; double time due when over 12 hours worked per day	CA687Z1P		\$57.69	\$73.27	\$88.85	X X H X X H H D Y
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Make up day allowed comment
Saturday

8/12/2016

Subdivision of county

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				
Cement Mason					
Cement Mason	br1cm	10/15/2014	\$50.05	\$71.17	\$92.28 X X H H H H D N
Apprentice Rates:					
	1st 6 months		\$29.13	\$39.45	\$49.77
	2nd 6 months		\$31.20	\$42.54	\$53.87
	3rd 6 months		\$35.31	\$48.67	\$62.01
	4th 6 months		\$39.46	\$54.85	\$70.23
	5th 6 months		\$41.52	\$57.91	\$74.30
	6th 6 months		\$45.67	\$64.10	\$82.52
Cement Mason	CE514	8/17/2016	\$48.55	\$68.40	\$88.24 H H D H H H H D N
Apprentice Rates:					
	1st 6 months		\$28.17	\$38.03	\$47.88
	2nd 6 months		\$30.14	\$40.98	\$51.82
	3rd 6 months		\$34.09	\$46.91	\$59.72
	4th 6 months		\$38.03	\$52.82	\$67.60
	5th 6 months		\$39.99	\$55.75	\$71.52
	6th 6 months		\$43.94	\$61.68	\$79.42
Drywall					
Drywall Taper	PT-22-D	8/25/2016	\$45.91	\$59.74	\$73.56 H H D H D D D D Y
Four 10s allowed Monday-Thursday					
<i>Make up day allowed comment</i>					
Friday make-up day for bad weather or holidays					
Apprentice Rates:					
	First 3 months		\$32.08	\$38.99	\$45.90
	Second 3 months		\$34.85	\$43.14	\$51.44
	Second 6 months		\$37.62	\$47.30	\$56.98
	Third 6 months		\$40.38	\$51.44	\$62.50
	4th 6 months		\$41.76	\$53.51	\$65.26

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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Classification		Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision	
Name	Description						
=====							
Electrician							
Inside Wireman	EC-58-IW	10/25/2016	\$61.78	\$82.23	\$102.67	H H H H H H H D N	
Apprentice Rates:							
	0-1000 hours		\$39.84	\$49.32	\$58.80		
	1000-2000 hours		\$41.84	\$52.32	\$62.79		
	2000-3500 hours		\$43.83	\$55.30	\$66.77		
	3500-5000 hours		\$45.83	\$58.30	\$70.76		
	5000-6500 hours		\$47.82	\$61.28	\$74.74		
	6500-8000 hours		\$51.81	\$67.28	\$82.73		
Sound and Communication Installer	EC-58-SC	1/3/2017	\$40.25	\$53.87	\$67.48	H H H H H H H D N	
Apprentice Rates:							
	Period 1		\$26.64	\$33.45	\$40.26		
	Period 2		\$28.00	\$35.49	\$42.98		
	Period 3		\$29.36	\$37.53	\$45.70		
	Period 4		\$30.73	\$39.58	\$48.44		
	Period 5		\$32.09	\$41.62	\$51.16		
	Period 6		\$33.44	\$43.65	\$53.86		
Elevator Constructor							
Elevator Constructor	EL 36	8/7/2007	\$56.46		\$94.99	D D D D D D D D Y	
Elevator Constructor							
Make up day allowed							
Apprentice Rates:							
	1st Year Apprentice		\$37.74		\$58.93		
	2nd Year Apprentice		\$41.90		\$66.94		
	3rd Year Apprentice		\$43.98		\$70.95		
	4th Year Apprentice		\$48.14		\$78.96		

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				

Glazier

Glazier GL-357 \$49.50 \$65.23 \$80.95 H H H H H H D Y
 If a four 10 hour day workweek is scheduled, four 10s must be consecutive, M-F.

8/24/2016

Apprentice Rates:

1st 6 months	\$33.77	\$41.63	\$49.49
2nd 6 months	\$35.35	\$44.00	\$52.65
3rd 6 months	\$38.49	\$48.71	\$58.93
4th 6 months	\$40.06	\$51.07	\$62.07
5th 6 months	\$41.64	\$53.43	\$65.23
6th 6 months	\$43.21	\$55.79	\$68.37
7th 6 months	\$44.78	\$58.15	\$71.51
8th 6 months	\$47.93	\$62.87	\$77.81

Heat and Frost Insulator

Spray Insulation AS25S \$25.29 \$36.51 X X X H H H H N
 6/2/2016

Heat and Frost Insulator and Asbestos Worker

Heat and Frost Insulators and Asbestos Workers AS25 \$62.65 \$78.41 \$94.16 H H H H H H D Y

Four 10s must be worked for a minimum of 2 weeks consecutively, Monday thru Thursday. All hours worked in excess of 10 will be paid at double time. All hours worked on the fifth day,

comment

6/3/2016

Four 10s must be worked for a minimum of 2 consecutive weeks. OVERTIME is different on a four 10 week. OT is 2x for hours beyond 10. All hours on fifth day, M-F require time and one half. Sat first 8 hours, 1.5, all hours after 8 require double time.

Apprentice Rates:

1st Year	\$46.90	\$54.78	\$62.66
2nd Year	\$50.05	\$59.50	\$68.96
3rd Year	\$53.20	\$64.23	\$75.26
4th Year	\$56.35	\$68.96	\$81.56

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				
=====					
Ironworker					
Fence, Sound Barrier & Guardrail erection/installation and Exterior Signage work	IR-25-F1		\$35.55	\$47.55	\$59.55 X X H X X X H D Y
Four ten hour work days may be worked during Monday-Saturday.					

3/11/2016

Apprentice Rates:

60% Level	\$25.15	\$32.35	\$39.55
65% Level	\$26.45	\$34.25	\$42.05
70% Level	\$27.76	\$36.16	\$44.56
75% Level	\$29.05	\$38.05	\$47.05
80% Level	\$30.35	\$39.95	\$49.55
85% Level	\$31.65	\$41.85	\$52.05

Siding, Glazing, Curtain Wall	IR-25-GZ2		\$47.16	\$58.82	\$70.48 X X H H H H D D Y
4 tens may be worked Monday thru Thursday @ straight time.					
<i>Make up day allowed comment</i>					
Friday					

6/5/2015

Apprentice Rates:

Level 1	\$30.23	\$36.84	\$43.43
Level 2	\$32.34	\$39.58	\$46.80
Level 3	\$34.46	\$42.33	\$50.19
Level 4	\$36.58	\$45.08	\$53.57
Level 5	\$38.69	\$47.82	\$56.95
Level 6	\$40.81	\$50.57	\$60.33

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Classification Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision
Pre-engineered Metal Work	IR-25-PE-Z1		\$47.49	\$58.03	\$68.56	X X H X X X X D Y
	<i>Make up day allowed comment</i>	4/6/2016				
	4 tens allowed M-Th with Saturday make up day					
	Apprentice Rates:					
	1st Year		\$28.36	\$34.09	\$39.81	
	3rd 6 month period		\$30.48	\$36.95	\$43.43	
	4th 6 month period		\$32.61	\$39.84	\$47.08	
	5th 6 month period		\$34.73	\$42.72	\$50.70	
	6th 6 month period		\$36.86	\$45.60	\$54.34	
Reinforced Iron Work	IR-25-RF		\$56.98	\$85.28	\$113.57	H H D H D D D D N
	<i>Make up day allowed</i>	8/19/2016				
	Apprentice Rates:					
	Level 1		\$37.63	\$54.83	\$72.77	
	Level 2		\$40.00	\$58.38	\$77.51	
	Level 3		\$42.36	\$63.05	\$83.73	
	Level 4		\$44.90	\$66.86	\$88.81	
	Level 5		\$47.43	\$69.53	\$92.37	
	Level 6		\$49.97	\$74.46	\$98.95	
Rigging Work	IR-25-RIG		\$62.83	\$93.95	\$125.06	H H H H H H H D N
		8/19/2016				
	Apprentice Rates:					
	Level 1 & 2		\$38.13	\$55.74	\$74.10	
	Level 3		\$40.96	\$61.12	\$81.26	
	Level 4		\$43.78	\$65.34	\$86.90	
	Level 5		\$46.61	\$69.59	\$92.56	
	Level 6		\$49.44	\$73.83	\$98.22	

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Classification Name Description	Last Updated	Straight Time and Hourly Half	a Double Time	Overtime Provision
Decking 4 tens may be worked Monday thru Thursday @ straight time. If bad weather, Friday may be a make up day. If holiday celebrated on a Monday, 4 10s may be worked Tuesday thru Friday. Work in excess of 12 hours per day must be paid @ double time. <i>Make up day allowed comment</i> Friday for 4 tens M-Th Saturday for 5 eights M-F	IR-25-SD 8/19/2016	\$54.79	\$81.86	\$108.92 X X H H H H D D Y
Structural, ornamental, welder and pre-cast 4 tens may be worked Monday thru Thursday @ straight time. If bad weather, Friday may be a make up day. If holiday celebrated on a Monday, 4 10s may be worked Tuesday thru Friday. Work in excess of 12 hours per day must be paid @ double time. <i>Make up day allowed</i>	IR-25-STR 8/19/2016	\$62.96	\$94.11	\$125.26 H H H H H H D D Y
Apprentice Rates:				
Levels 1 & 2		\$38.13	\$56.87	\$75.60
Level 3		\$40.96	\$61.12	\$81.26
Level 4		\$43.78	\$65.34	\$86.90
Level 5		\$46.61	\$69.59	\$92.56
Level 6		\$49.44	\$73.83	\$98.22
Level 7		\$52.26	\$78.06	\$103.86
Level 8		\$55.09	\$82.31	\$109.52
Industrial Door erection & construction <i>Make up day allowed comment</i> Friday for bad weather when 4 tens scheduled for M-Th. If holiday celebrated on M, 4 tens may be worked T-F. Work in excess of 12 hours per day must be paid @ double time.	IR-25-STR-D 8/19/2016	\$43.05	\$64.25	\$85.45 H H H H H H D D Y

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				

Laborer

Construction Laborer, Demolition Laborer, Mason Tender, Carpenter Tender, Drywall Handler, Concrete Laborer, Cement Finisher tender, concrete chute and concrete Bucket Handler, Concrete Laborer	L1076-A-A	\$44.35	\$63.10	\$81.85	H H H H H H H D Y
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If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 hours of work on Saturdays @ straight time.

Make up day allowed comment 6/16/2016
Saturday

Apprentice Rates:

0-1,000 work hours	\$38.33	\$54.07	\$69.81
1,001-2,000 work hours	\$39.53	\$55.87	\$72.21
2,001-3,000 work hours	\$40.73	\$57.67	\$74.61
3,001-4,000 work hours	\$43.15	\$61.30	\$79.45

Signal man (on sewer & caisson work); air,electric or gasoline tool operator (including concrete vibrator operator,acetylene torch & air hammer operator); scaffold builder, caisson worker	L1076-A-B	\$44.62	\$63.51	\$82.39	H H H H H H H D Y
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If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 hours of work on Saturdays @ straight time.

Make up day allowed comment 6/16/2016
Saturday

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Classification		Last Updated	Straight Time and Hourly	a Double Time Half	Overtime Provision
Name	Description				
Lansing Burner, Blaster & Powder Man	L1076-A-C		\$45.13	\$64.27	\$83.41 H H H H H H D Y
<p>If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 hours of work on Saturdays @ straight time.</p> <p><i>Make up day allowed comment</i> 6/16/2016</p> <p>Saturday</p>					
Furnance battery heater tender, burning bar & oxy-acetylene gun	L1076-A-D		\$44.86	\$63.87	\$82.87 H H H H H H D Y
<p>If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 hours of work on Saturdays @ straight time.</p> <p><i>Make up day allowed comment</i> 6/16/2016</p> <p>Saturday</p>					
Cleaner/sweeper laborer, furniture laborer - unloading of furniture to the point of installation, the setting in place or relocation of furniture	L1076-A-E		\$38.90	\$54.93	\$70.95 H H H H H H D Y
<p>If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 hours of work on Saturdays @ straight time.</p> <p><i>Make up day allowed comment</i> 1/4/2017</p> <p>Saturday</p>					

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Classification							
Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision	

Expediter man, topman and/or bottom man (blast furnace work or battery work)	L1076-A-F		\$45.64	\$65.04	\$84.43	H H H H H H H D Y
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If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 hours of work on Saturdays @ straight time.

comment

6/16/2016

Saturday

Plasterer Tender, Plastering Machine Operator	LPT-1		\$44.35	\$63.10	\$81.85	H H H H H H H D Y
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If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8

Make up day allowed comment

6/17/2016

Saturday

Apprentice Rates:

1,001 - 2,000 hours	\$39.53	\$55.87	\$72.21
2,001 - 3,000 hours	\$40.73	\$57.67	\$74.61
3,001 - 4,000 hours	\$43.15	\$61.30	\$79.45

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Classification									
Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision			
=====									
Laborer - Hazardous									
Class A Laborer - performing work in conjunction with site preparation and other preliminary work prior to actual removal, handling, or containment of hazardous waste substances not requiring use of personal protective equipment required by state or federal regulations; or a laborer performing work in conjunction with the removal, handling, or containment of hazardous waste substances when used of personal protective equipment level "D" is required.	LHAZ-Z2-A		\$43.54	\$61.94	\$80.33	H H H H H H H D Y			
<i>Make up day allowed comment</i>		11/1/2013							
4 10s allowed M-Th or T-F; inclement weather makeup day Friday									
Apprentice Rates:									
0-1,000 work hours			\$37.60	\$53.03	\$68.45				
1,001-2,000 work hours			\$38.79	\$54.81	\$70.83				
2,001-3,000 work hours			\$39.98	\$56.60	\$73.21				
3,001-4,000 work hours			\$42.35	\$60.15	\$77.95				
Class B Laborer - performing work in conjunction with the removal, handling, or containment of hazardous waste substances when the use of personal protective equipment levels "A", "B" or "C" is required.	LHAZ-Z2-B		\$44.54	\$63.44	\$82.33	H H H H H H H D Y			
<i>Make up day allowed comment</i>		11/7/2014							
4 10s allowed M-Th or T-F; inclement weather makeup day Friday									
Apprentice Rates:									
0-1,000 work hours			\$38.36	\$54.17	\$69.97				
1,001-2,000 work hours			\$39.59	\$56.01	\$72.43				
2,001-3,000 work hours			\$40.83	\$57.87	\$74.91				
3,001-4,000 work hours			\$43.30	\$61.58	\$79.85				

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Classification		Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision				
Name	Description									

Laborer Underground - Tunnel, Shaft & Caisson

Class I - Tunnel, shaft and caisson laborer, dump man, shanty man, hog house tender, testing man (on gas), and watchman. LAUCT-Z1-1 \$37.87 \$48.66 \$59.44 X X X X X X D Y

9/6/2013

Apprentice Rates:

0-1,000 work hours	\$33.05	\$41.43	\$49.80
1,001-2,000 work hours	\$34.02	\$42.88	\$51.74
2,001-3,000 work hours	\$34.98	\$44.32	\$53.66
3,001-4,000 work hours	\$36.91	\$47.21	\$57.52

Class II - Manhole, headwall, catch basin builder, bricklayer tender, mortar man, material mixer, fence erector, and guard rail builder. LAUCT-Z1-2 \$37.98 \$48.82 \$59.66 X X X X X X D Y

9/6/2013

Apprentice Rates:

0-1,000 work hours	\$33.14	\$41.56	\$49.98
1,001-2,000 work hours	\$34.10	\$43.00	\$51.90
2,001-3,000 work hours	\$35.07	\$44.45	\$53.84
3,001-4,000 work hours	\$37.01	\$47.37	\$57.72

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Classification Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision
=====						
Class III - Air tool operator (jack hammer man, bush hammer man and grinding man), first bottom man, second bottom man, cage tender, car pusher, carrier man, concrete man, concrete form man, concrete repair man, cement invert laborer, cement finisher, concrete shoveler, conveyor man, floor man, gasoline and electric tool operator, gunnite man, grout operator, welder, heading dinky man, inside lock tender, pea gravel operator, pump man, outside lock tender, scaffold man, top signal man, switch man, track man, tugger man, utility man, vibrator man, winch operator, pipe jacking man, wagon drill and air track operator and concrete saw operator (under 40 h.p.).	LAUCT-Z1-3		\$38.04	\$48.91	\$59.78	X X X X X X D Y

9/6/2013

Apprentice Rates:

0-1,000 work hours	\$33.18	\$41.62	\$50.06
1,001-2,000 work hours	\$34.15	\$43.07	\$52.00
2,001-3,000 work hours	\$35.12	\$44.53	\$53.94
3,001-4,000 work hours	\$37.07	\$47.45	\$57.84

Class IV - Tunnel, shaft and caisson mucker, bracer man, liner plate man, long haul dinky driver and well point man.	LAUCT-Z1-4		\$38.22	\$49.18	\$60.14	X X X X X X D Y
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9/6/2013

Apprentice Rates:

0-1,000 work hours	\$33.32	\$41.83	\$50.34
1,001-2,000 work hours	\$34.30	\$43.30	\$52.30
2,001-3,000 work hours	\$35.28	\$44.77	\$54.26
3,001-4,000 work hours	\$37.24	\$47.71	\$58.18

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Classification Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision
=====						
Class V - Tunnel, shaft and caisson miner, drill runner, keyboard operator, power knife operator, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars)	LAUCT-Z1-5		\$38.47	\$49.56	\$60.64	X X X X X X D Y
		9/6/2013				
	Apprentice Rates:					
	0-1,000 work hours		\$33.50	\$42.10	\$50.70	
	1,001-2,000 work hours		\$34.50	\$43.60	\$52.70	
	2,001-3,000 work hours		\$35.49	\$45.09	\$54.68	
	3,001-4,000 work hours		\$37.48	\$48.07	\$58.66	
Class VI - Dynamite man and powder man.	LAUCT-Z1-6		\$38.80	\$50.05	\$61.30	X X X X X X D Y
		9/6/2013				
	Apprentice Rates:					
	0-1,000 work hours		\$33.75	\$42.47	\$51.20	
	1,001-2,000 work hours		\$34.76	\$43.99	\$53.22	
	2,001-3,000 work hours		\$35.77	\$45.51	\$55.24	
	3,001-4,000 work hours		\$37.79	\$48.53	\$59.28	
Class VII - Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes and flagstones.	LAUCT-Z1-7		\$32.08	\$39.97	\$47.86	X X X X X X D Y
		9/6/2013				
	Apprentice Rates:					
	0-1,000 work hours		\$28.71	\$34.91	\$41.12	
	1,001-2,000 work hours		\$29.38	\$35.92	\$42.46	
	2,001-3,000 work hours		\$30.06	\$36.94	\$43.82	
	3,001-4,000 work hours		\$31.41	\$38.97	\$46.52	

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Classification		Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision	
Name	Description						
=====							
Landscape Laborer							
	Landscape Specialist includes air, gas, and diesel equipment operator, skidsteer (or equivalent), lawn sprinkler installer on landscaping work where seeding, sodding, planting, cutting, trimming, backfilling, rough grading or maintenance of landscape projects occurs.	LLAN-Z1-A	\$28.98	\$40.04	\$51.09	X X H X X X H D Y	

Sundays paid at time & one half. Holidays paid at double time.

10/13/2015

	Skilled Landscape Laborer: small power tool operator, lawn sprinkler installers' tender, material mover, truck driver when seeding, sodding, planting, cutting, trimming, backfilling, rough grading or maintaining of landscape projects occurs	LLAN-Z1-B	\$24.76	\$33.71	\$42.65	X X H X X X H D Y	
Sundays paid at time & one half. Holidays paid at double time.							

10/13/2015

Marble Finisher

	Marble Finisher	BR1-MF	\$43.48	\$54.29	\$65.10	H H D H D D D D Y	
A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.							

10/20/2014

Apprentice Rates:

Level 1	\$19.04	\$25.12	\$31.20
Level 2	\$20.24	\$26.92	\$33.60
Level 3	\$27.01	\$33.96	\$40.90
Level 4	\$28.47	\$36.14	\$43.82
Level 5	\$29.99	\$37.84	\$45.70
Level 6	\$31.61	\$39.86	\$48.10
Level 7	\$33.30	\$41.59	\$49.87
Level 8	\$34.79	\$43.48	\$52.17

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Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				
=====					
Marble Mason					
Marble Mason	BR1-MM		\$50.29	\$64.51	\$78.72 H H D H D D D D Y
A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.					
10/17/2014					
Apprentice Rates:					
Level 1			\$25.14	\$32.65	\$40.15
Level 2			\$28.20	\$36.49	\$44.78
Level 3			\$33.41	\$41.97	\$50.53
Level 4			\$36.15	\$45.66	\$55.17
Level 5			\$38.42	\$48.17	\$57.92
Level 6			\$42.07	\$53.56	\$65.05
Level 7			\$42.74	\$54.38	\$66.02
Level 8			\$43.67	\$55.78	\$67.88

Operating Engineer

Crane with boom & jib or leads 120' or longer	EN-324-A120		\$58.61	\$76.37	\$94.13 X X H H D D D D Y
<i>comment</i>		7/28/2016			
Double time after 12 hours M-F					
Crane with boom & jib or leads 140' or longer	EN-324-A140		\$59.43	\$77.60	\$95.77 X X H H D D D D Y
Work in excess of 12 per day M-F shall be paid at double time.		7/28/2016			
Crane with boom & jib or leads 220' or longer	EN-324-A220		\$59.73	\$78.05	\$96.37 X X H H D D D D Y
Work in excess of 12 per day M-F shall be paid at double time.		7/28/2016			
Crane with boom & jib or leads 300' or longer	EN-324-A300		\$61.23	\$80.30	\$99.37 X X H H D D D D Y
Work in excess of 12 per day M-F shall be paid at double time.		7/28/2016			

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

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Classification Name Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision
Crane with boom & jib or leads 400' or longer Work in excess of 12 per day M-F shall be paid at double time.	EN-324-A400	\$62.73	\$82.55	\$102.37	X X H H D D D D Y
	7/28/2016				
Compressor or welding machine Work in excess of 12 per day M-F shall be paid at double time.	EN-324-CW	\$47.76	\$60.10	\$72.43	X X H H D D D D Y
	7/28/2016				
Forklift, lull, extend-a-boom forklift Work in excess of 12 per day M-F shall be paid at double time.	EN-324-FL	\$55.07	\$71.06	\$87.05	X X H H D D D D Y
	7/28/2016				
Fireman or oiler Work in excess of 12 per day M-F shall be paid at double time.	EN-324-FO	\$46.73	\$58.55	\$70.37	X X H H D D D D Y
	7/28/2016				
Regular crane, job mechanic, concrete pump with boom Work in excess of 12 per day M-F shall be paid at double time.	EN-324-RC	\$57.75	\$75.08	\$92.41	X X H H D D D D Y
	7/27/2016				
Regular engineer, hydro-excavator, remote controlled concrete breaker Work in excess of 12 per day M-F shall be paid at double time.	EN-324-RE	\$56.78	\$73.63	\$90.47	X X H H D D D D Y
	7/27/2016				

Apprentice Rates:

0-999 hours	\$46.35	\$58.48	\$70.61
1,000-1,999 hours	\$48.09	\$61.10	\$74.09
2,000-2,999 hours	\$49.82	\$63.68	\$77.55
3,000-3,999 hours	\$51.55	\$66.28	\$81.01
4,000-4,999 hours	\$53.29	\$68.90	\$84.49
5,000-5,999 hours	\$55.01	\$71.47	\$87.93

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Official 2017 Prevailing Wage Rates for State Funded Projects

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Classification									
Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision			
=====									
Operating Engineer - DIVER									
Diver/Wet Tender/Tender/Rov Pilot/Rov Tender	GLF D	4/2/2014	\$52.80	\$79.20	\$105.60	H H H H H H D N			
Operating Engineer - Marine Construction									
Diver/Wet Tender, Engineer (hydraulic dredge)	GLF-1		\$72.32	\$93.82	\$115.32	X X H H H H D Y			
<i>Make up day allowed</i> 1/23/2017									
<u>Subdivision of county</u> all Great Lakes, islands therein, & connecting & tributary waters									
Crane/Backhoe Operator, 70 ton or over Tug Operator, Mechanic/Welder, Assistant Engineer (hydraulic dredge), Leverman (hydraulic dredge), Diver Tender	GLF-2		\$70.82	\$91.57	\$112.32	X X H H H H D Y			
Holiday pay = 2.5 times the straight hourly rate									
<i>Make up day allowed</i> 1/23/2017									
<u>Subdivision of county</u> All Great Lakes, islands therein, & connecting & tributary waters									
Friction, Lattice Boom or Crane License Certification	GLF-2B		\$72.32	\$93.82	\$115.32	X X H H H H D Y			
Holiday pay = 2.5 times the straight hourly rate									
<i>Make up day allowed</i> 1/23/2017									
<u>Subdivision of county</u> All Great Lakes, islands, therein, & connecting & tributary waters									
Deck Equipment Operator, Machineryman, Maintenance of Crane (over 50 ton capacity) or Backhoe (115,000 lbs or more), Tug/Launch Operator, Loader, Dozer on Barge, Deck Machinery	GLF-3		\$66.27	\$84.75	\$103.22	X X H H H H D Y			
Holiday pay = 2.5 times the straight hourly rate									
<i>Make up day allowed</i> 1/23/2017									
<u>Subdivision of county</u> All Great Lakes, islands therein, & connecting & tributary waters									

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Statewide

Official Rate Schedule

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Classification Name	Description	Last Updated	Straight Time and Hourly	a Double Half	Time	Overtime Provision
Deck Equipment Operator, (Machineryman/Fireman), (4 equipment units or more), Off Road Trucks, Deck Hand, Tug Engineer, & Crane Maintenance 50 ton capacity and under or Backhoe 115,000 lbs or less, Assistant Tug Operator	GLF-4		\$60.07	\$75.45	\$90.82	X X H H H H H D Y

Holiday pay = 2.5 times the straight hourly rate

Make up day allowed

1/23/2017

Subdivision of county

All Great Lakes, islands therein, & connecting & tributary waters

Operating Engineer Steel Work

Forklift, 1 Drum Hoist	EN-324-ef		\$59.66	\$78.12	\$96.58	H H D H H H D D Y
Make up day allowed comment		8/4/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 120' boom or longer	EN-324-SW120		\$62.36	\$82.17	\$101.98	H H D H H H D D Y
Make up day allowed comment		8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 120' boom or longer w/ Oiler	EN-324-SW120-O		\$63.36	\$83.67	\$103.98	H H D H H H D D Y
Make up day allowed comment		8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 140' boom or longer	EN-324-SW140		\$63.54	\$83.94	\$104.34	H H D H H H D D Y
Make up day allowed comment		8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 140' boom or longer W/ Oiler	EN-324-SW140-O		\$64.54	\$85.44	\$106.34	H H D H H H D D Y
Make up day allowed comment		8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather						
Boom & Jib 220' or longer	EN-324-SW220		\$63.81	\$84.35	\$104.88	H H D H H H D D Y
Make up day allowed comment		8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather						
Crane w/ 220' boom or longer w/ Oiler	EN-324-SW220-O		\$64.81	\$85.85	\$106.88	H H D H H H D D Y
Make up day allowed comment		8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather						

Official Request #: 98

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Project Description: Larson Middle School Office Renovation, International Academy

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Classification Name Description	Last Updated	Straight Time and Hourly Half	a Double Time	Overtime Provision
Boom & Jib 300' or longer Make up day allowed comment 4 10s allowed M-Th with Friday makeup day because of bad weather	EN-324-SW300 8/5/2016	\$65.31	\$86.60	\$107.88 H H D H H H D D Y
Crane w/ 300' boom or longer w/ Oiler Make up day allowed comment 4 10s allowed M-Th with Friday makeup day because of bad weather	EN-324-SW300-O 8/5/2016	\$66.31	\$88.10	\$109.88 H H D H H H D D Y
Boom & Jib 400' or longer Make up day allowed comment 4 10s allowed M-Th with Friday makeup day because of bad weather	EN-324-SW400 8/5/2016	\$66.81	\$88.80	\$110.82 H H D H H H D D Y
Crane w/ 400' boom or longer w/ Oiler Make up day allowed comment 4 10s allowed M-Th with Friday makeup day because of bad weather	EN-324-SW400-O 8/5/2016	\$67.81	\$90.35	\$112.88 H H D H H H D D Y
Crane Operator, Job Mechanic, 3 Drum Hoist & Excavator Make up day allowed comment 4 10s allowed M-Th with Friday makeup day because of bad weather	EN-324-SWCO 8/5/2016	\$62.00	\$81.63	\$101.26 H H D H H H D D Y
Apprentice Rates:				
	0-999 hours	\$49.22	\$62.96	\$76.70
	1,000-1,999 hours	\$51.18	\$65.90	\$80.62
	2,000-2,999 hours	\$53.15	\$68.85	\$84.56
	3,000-3,999 hours	\$55.11	\$71.80	\$88.48
	4,000-4,999 hours	\$57.07	\$74.74	\$92.40
	5,000 hours	\$59.04	\$77.69	\$96.34
Crane Operator w/ Oiler Make up day allowed comment 4 10s allowed M-Th with Friday makeup day because of bad weather	EN-324-SWCO-O 8/5/2016	\$63.00	\$83.13	\$103.26 H H D H H H D D Y
Compressor or Welder Operator Make up day allowed comment 4 10s allowed M-Th with Friday makeup day because of bad weather	EN-324-SWCW 8/5/2016	\$54.55	\$70.46	\$86.36 H H D H H H D D Y

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Classification Name Description	Last Updated	Straight Time and Hourly Half	a Double Time	Overtime Provision
Hoisting Operator, 2 Drum Hoist, & Rubber Tire Backhoe	EN-324-SWHO	\$61.36	\$80.67	\$99.98 H H D H H H D D Y
<i>Make up day allowed comment</i> 8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather				
Oiler	EN-324-SWO	\$53.14	\$68.34	\$83.54 H H D H H H D D Y
<i>Make up day allowed comment</i> 8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather				
Tower Crane & Derrick where work is 50' or less	EN-324-SWTD50	\$63.09	\$83.27	\$103.44 H H D H H H D D Y
<i>Make up day allowed comment</i> 8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather				
Tower Crane & Derrick 50' or more w/ Oiler	EN-324-SWTD50-O	\$64.09	\$84.77	\$105.44 H H D H H H D D Y
<i>Make up day allowed comment</i> 8/5/2016				
4 10s allowed M-Th with Friday makeup day because of bad weather				

Operating Engineer Underground

Class I Equipment	EN-324A1-UC1	\$54.54	\$70.33	\$86.12 H H H H H H H D Y
<i>Make up day allowed comment</i> 12/6/2016				
Apprentice Rates:				
0-999 hours		\$43.26	\$54.31	\$65.36
1,000-1,999 hours		\$44.84	\$56.68	\$68.52
2,000-2,999 hours		\$46.43	\$59.07	\$71.70
3,000-3,999 hours		\$48.00	\$61.42	\$74.84
4,000-4,999 hours		\$49.58	\$63.79	\$78.00
5,000-5,999 hours		\$51.16	\$66.17	\$81.16
Class II Equipment	EN-324A1-UC2	\$49.81	\$63.24	\$76.66 H H H H H H H D Y
<i>Make up day allowed comment</i> 12/6/2016				
Class III Equipment	EN-324A1-UC3	\$49.08	\$62.14	\$75.20 H H H H H H H D Y
<i>Make up day allowed comment</i> 12/6/2016				
Class IV Equipment	EN-324A1-UC4	\$48.51	\$61.29	\$74.06 H H H H H H H D Y
<i>Make up day allowed comment</i> 12/6/2016				

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				

Master Mechanic	EN-324A1-UMM	\$54.79	\$70.71	\$86.62	H H H H H H H D Y
	12/6/2016				

Painter

Painter (8 hours of repaint work performed on Sunday shall be paid time & one half rate)	PT-22-P	\$44.32	\$57.60	\$70.88	H H D H D D D D Y
--	---------	---------	---------	---------	-------------------

Four 10s allowed Monday-Thursday with Friday makeup day if job down due to weather, holiday or other conditions beyond the control of the employer.

Make up day allowed comment 8/25/2016

Fridays for bad weather or holidays

Apprentice Rates:

Year 1	\$31.04	\$37.68	\$44.32
Year 2	\$33.70	\$41.67	\$49.64
Year 3	\$36.35	\$45.64	\$54.94
Year 4	\$40.34	\$51.63	\$62.92
Fifth 6 months	\$38.36	\$48.79	\$59.21
Final 6 months	\$39.66	\$50.73	\$61.81

Pipe and Manhole Rehab

General Laborer for rehab work or normal cleaning and cctv work-top man, scaffold man, CCTV assistant, jetter-vac assistant	TM247	\$28.20	\$38.20	H H H H H H H H N
	4/17/2015			

Tap cutter/CCTV Tech/Grout Equipment Operator: unit driver and operator of CCTV; grouting equipment and tap cutting equipment	TM247-2	\$32.70	\$44.95	H H H H H H H H N
	4/17/2015			

CCTV Technician/Combo Unit Operator: unit driver and operator of cctv unit or combo unit in connection with normal cleaning and televising work	TM247-3	\$31.45	\$43.07	H H H H H H H H N
	4/17/2015			

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Classification Name Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision
Boiler Operator: unit driver and operator of steam/water heater units and all ancillary equipment associated	TM247-4 4/17/2015	\$33.20	\$45.70		H H H H H H H N
Combo Unit driver & Jetter-Vac Operator	TM247-5 4/17/2015	\$33.20	\$45.70		H H H H H H H N
Pipe Bursting & Slip-lining Equipment Operator	TM247-6 4/17/2015	\$34.20	\$47.20		H H H H H H H N

Pipefitter

Pipefitter	PF-636	\$69.83	\$91.03	\$108.23	H	H	D	H	D	D	D	D	Y
comment		7/12/2016											
Four 10s allowed during the week preceding, following and/or the week of a holiday.													

Apprentice Rates:

1st & 2nd periods	\$29.93	\$38.28	\$45.28
3rd period	\$31.93	\$41.28	\$49.28
4th period	\$33.18	\$43.16	\$51.78
5th period	\$34.43	\$45.03	\$54.28
6th period	\$35.68	\$46.90	\$56.78
7th period	\$36.93	\$48.78	\$59.28
8th period	\$37.93	\$50.28	\$61.28
9th period	\$38.93	\$51.78	\$63.28
10th period	\$40.36	\$53.92	\$66.14

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<u>Classification</u>		<u>Last</u>	<u>Straight</u>	<u>Time and</u>	<u>a Double</u>	<u>Overtime</u>						
Name	Description	Updated	Hourly	Half	Time	Provision						
=====												
Plasterer												
Plasterer		BR1P		\$45.04	\$67.56	\$90.08	H	H	H	H	H	D N
Make up day allowed comment		11/1/2012										
Saturday												
Apprentice Rates:												
1st 6 months			\$32.11	\$48.17	\$64.22							
2nd 6 months			\$33.40	\$50.10	\$66.80							
3rd 6 months			\$34.69	\$52.04	\$69.38							
4th 6 months			\$37.28	\$55.92	\$74.56							
5th 6 months			\$39.87	\$59.81	\$79.74							
6th 6 months			\$42.45	\$63.68	\$84.90							
Plasterer		PL67		\$44.72	\$60.11	\$75.50	H	H	H	X	D D D D N	
		9/8/2010										
Apprentice Rates:												
1st 6 months			\$29.33	\$37.02	\$44.72							
2nd 6 months			\$30.87	\$39.34	\$47.80							
3rd 6 months			\$32.41	\$41.64	\$50.88							
4th 6 months			\$35.49	\$46.26	\$57.04							
5th 6 months			\$38.56	\$51.16	\$63.76							
6th 6 months			\$41.64	\$55.49	\$69.34							

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Classification		Last	Straight Time and	a Double	Overtime	
Name	Description	Updated	Hourly	Half	Time	Provision
=====						

Plumber

Plumber PL-98 \$64.45 \$84.87 \$101.29 H H D H D D D D Y

comment 7/18/2013

4 tens allowed M-Th or T-F; OT of time and one half required on 11th & 12th hour of any ten hour days

Apprentice Rates:

Period 1	\$19.93	\$26.43	\$32.93
Period 2	\$23.90	\$31.40	\$38.90
Period 3	\$30.60	\$39.19	\$47.77
Period 4	\$31.23	\$40.13	\$49.03
Period 5	\$32.39	\$41.87	\$51.35
Period 6	\$33.54	\$43.59	\$53.65
Period 7	\$34.69	\$45.32	\$55.95
Period 8	\$35.86	\$47.07	\$58.29
Period 9	\$37.01	\$48.80	\$60.59
Period 10	\$38.16	\$50.53	\$62.89

Roofer

Commercial Roofer RO-149-WOM \$55.93 \$70.93 \$85.93 X X H X X H H D N

9/27/2016

Apprentice Rates:

new apprentice	\$37.34	\$45.07	\$52.80
Apprentice 1	\$41.85	\$49.81	\$57.77
Apprentice 2	\$42.36	\$50.57	\$58.79
Apprentice 3	\$43.87	\$52.84	\$61.81
Apprentice 4	\$45.37	\$55.09	\$64.81
Apprentice 5	\$46.88	\$57.35	\$67.83
Apprentice 6	\$48.29	\$59.47	\$70.65
Apprentice 7	\$49.90	\$61.89	\$73.87
Apprentice 8	\$51.41	\$64.15	\$76.89

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

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Classification		Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision	
Name	Description						
Sewer Relining							
Class I-Operator of audio visual CCTV system including remote in-ground cutter and other equipment used in conjunction with CCTV	SR-I	11/24/2015	\$43.66	\$59.01	\$74.36	H H H H H H H D N	
Class II-Operator of hot water heaters and circulation system; water jetters; and vacuum and mechanical debris removal systems and those assisting.	SR-II	11/24/2015	\$42.13	\$56.72	\$71.30	H H H H H H H D N	
Sheet Metal Worker							
Sheet Metal Worker A 4 10 schedule may be worked, 4 consecutive days Monday thru Friday.	SHM-80	8/30/2016	\$64.50	\$82.20	\$99.89	H H D X H H H D Y	
Apprentice Rates:							
1st & 2nd Periods			\$40.99	\$48.95	\$56.92		
3rd & 4th Periods			\$42.75	\$51.60	\$60.44		
5th & 6th Periods			\$44.52	\$54.26	\$63.98		
7th & 8th Periods			\$46.29	\$56.91	\$67.52		

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				

Sprinkler Fitter

Sprinkler Fitter SP 704 \$66.92 \$85.66 \$104.39 H H D H D D D D Y
 4 ten hour days allowed Monday-Friday
 Double time pay due after 12 hours worked M-F

1/3/2017

Apprentice Rates:

1st Period	\$29.27	\$37.92	\$46.57
2nd Period	\$43.13	\$52.86	\$62.59
3rd Period	\$45.29	\$56.10	\$66.91
4th Period	\$47.45	\$59.34	\$71.23
5th Period	\$49.62	\$62.59	\$75.57
6th Period	\$51.78	\$65.83	\$79.89
7th Period	\$53.94	\$69.07	\$84.21
8th Period	\$56.10	\$72.31	\$88.53
9th Period	\$58.27	\$75.57	\$92.87
10th Period	\$60.43	\$78.81	\$97.19

Terrazzo

Terrazzo Finisher BR1-TRF \$43.97 \$55.03 \$66.08 H H D H D D D D Y
 A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.

10/17/2014

Apprentice Rates:

Level 1	\$19.04	\$25.12	\$31.20
Level 2	\$20.24	\$26.92	\$33.60
Level 3	\$27.01	\$33.96	\$40.90
Level 4	\$28.47	\$36.14	\$43.82
Level 5	\$29.99	\$37.84	\$45.70
Level 6	\$31.61	\$39.86	\$48.10
Level 7	\$33.30	\$41.59	\$49.87
Level 8	\$34.79	\$43.48	\$52.17

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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Classification		Last Updated	Straight Time and a Double	Overtime
Name	Description	Hourly	Half Time	Provision
=====				
Terrazzo Worker	BR1-TRW	\$49.73	\$63.67	\$77.60 H H D H D D D Y
A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.				

10/17/2014

Apprentice Rates:

Level 1	\$25.14	\$32.65	\$40.15
Level 2	\$28.20	\$36.49	\$44.78
Level 3	\$33.41	\$41.97	\$50.53
Level 4	\$36.15	\$45.66	\$55.17
Level 5	\$38.42	\$48.17	\$57.92
Level 6	\$42.07	\$53.56	\$65.05
Level 7	\$42.74	\$54.38	\$66.02
Level 8	\$43.67	\$55.78	\$67.88

Tile

Tile Finisher	BR1-TF	\$43.50	\$54.32	\$65.14 H H D H D D D Y
A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.				

10/17/2014

Apprentice Rates:

Level 1	\$19.04	\$25.12	\$31.20
Level 2	\$20.24	\$26.92	\$33.60
Level 3	\$27.01	\$33.96	\$40.90
Level 4	\$28.47	\$36.14	\$43.82
Level 5	\$29.99	\$37.84	\$45.70
Level 6	\$31.61	\$39.86	\$48.10
Level 7	\$33.30	\$41.59	\$49.87
Level 8	\$34.79	\$43.48	\$52.17

Official Request #: 98

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				
Tile Layer	BR1-TL		\$49.68	\$63.59	\$77.50 H H D H D D D D Y
A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.					

10/17/2014

Apprentice Rates:

Level 1	\$25.14	\$32.65	\$40.15
Level 2	\$28.20	\$36.49	\$44.78
Level 3	\$33.41	\$41.97	\$50.53
Level 4	\$36.15	\$45.66	\$55.17
Level 5	\$38.42	\$48.17	\$57.92
Level 6	\$42.07	\$53.56	\$65.05
Level 7	\$42.74	\$54.38	\$66.02
Level 8	\$43.67	\$55.78	\$67.88

Truck Driver

on all trucks of 8 cubic yard capacity or less (except dump trucks of 8 cubic yard capacity or over, tandem axle trucks, transit mix and semis, euclid type equipment, double bottoms and low boys)	TM-RB1	\$44.10	\$48.81	H H H H H H H H Y
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6/7/2016

of all trucks of 8 cubic yard capacity or over	TM-RB1A	\$44.20	\$48.96	H H H H H H H H Y
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6/7/2016

on euclid type equipment Make up day allowed	TM-RB1B	\$44.35	\$49.19	H H H H H H H H Y
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6/7/2016

Official Request #: 98

Requestor: Troy School District

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Project Number: Bid Package 19, BID 9834

County: Oakland

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Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

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Classification									
Name	Description	Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision			

Underground Laborer Open Cut, Class I

Construction Laborer	LAUC-Z1-1	9/5/2013	\$37.72	\$48.43	\$59.14	X X X X X X X D Y
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Apprentice Rates:

0-1,000 work hours	\$32.94	\$41.26	\$49.58
1,001-2,000 work hours	\$33.90	\$42.70	\$51.50
2,001-3,000 work hours	\$34.85	\$44.13	\$53.40
3,001-4,000 work hours	\$36.76	\$46.99	\$57.22

Underground Laborer Open Cut, Class II

Mortar and material mixer, concrete form man, signal man, well point man, manhole, headwall and catch basin builder, guard rail builders, headwall, seawall, breakwall, dock builder and fence erector.	LAUC-Z1-2	10/25/2013	\$37.83	\$48.60	\$59.36	X X X X X X X D Y
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Apprentice Rates:

0-1,000 work hours	\$33.02	\$41.38	\$49.74
1,001-2,000 work hours	\$33.98	\$42.82	\$51.66
2,001-3,000 work hours	\$34.95	\$44.27	\$53.60
3,001-4,000 work hours	\$36.87	\$47.15	\$57.44

Underground Laborer Open Cut, Class III

Air, gasoline and electric tool operator, vibrator operator, drillers, pump man, tar kettle operator, bracers, rodger, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars, etc.), cement finisher, welder, pipe jacking and boring man, wagon drill and air track operator and concrete saw operator (under 40 h.p.), windlass and tugger man, and directional boring man.	LAUC-Z1-3	9/5/2013	\$37.88	\$48.67	\$59.46	X X X X X X X D Y
--	-----------	----------	---------	---------	---------	-------------------

Apprentice Rates:

0-1,000 work hours	\$33.06	\$41.44	\$49.82
1,001-2,000 work hours	\$34.02	\$42.88	\$51.74
2,001-3,000 work hours	\$34.99	\$44.33	\$53.68
3,001-4,000 work hours	\$36.92	\$47.23	\$57.54

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

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Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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Classification		Last Updated	Straight Time and Hourly	a Double Time	Overtime Provision
Name	Description				

Underground Laborer Open Cut, Class IV

Trench or excavating grade man. LAUC-Z1-4 9/5/2013 \$37.96 \$48.79 \$59.62 X X X X X X D Y

Apprentice Rates:

0-1,000 work hours	\$33.12	\$41.53	\$49.94
1,001-2,000 work hours	\$34.09	\$42.99	\$51.88
2,001-3,000 work hours	\$35.06	\$44.44	\$53.82
3,001-4,000 work hours	\$36.99	\$47.33	\$57.68

Underground Laborer Open Cut, Class V

Pipe Layer LAUC-Z1-5 9/5/2013 \$38.02 \$48.88 \$59.74 X X X X X X D Y

Apprentice Rates:

0-1,000 work hours	\$33.16	\$41.59	\$50.02
1,001-2,000 work hours	\$34.14	\$43.06	\$51.98
2,001-3,000 work hours	\$35.11	\$44.51	\$53.92
3,001-4,000 work hours	\$37.05	\$47.43	\$57.80

Underground Laborer Open Cut, Class VI

Grouting man, top man assistant, audio visual television operations and all other operations in connection with closed circuit television inspection, pipe cleaning and pipe relining work and the installation and repair of water service pipe and appurtenances. LAUC-Z1-6 9/5/2013 \$35.47 \$45.06 \$54.64 X X X X X X D Y

Apprentice Rates:

0-1,000 work hours	\$31.25	\$38.73	\$46.20
1,001-2,000 work hours	\$32.10	\$40.00	\$47.90
2,001-3,000 work hours	\$32.94	\$41.26	\$49.58
3,001-4,000 work hours	\$34.63	\$43.79	\$52.96

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

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Official 2017 Prevailing Wage Rates for State Funded Projects

Issue Date: 1/24/2017

Contract must be awarded by: 4/24/2017

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Classification		Last Updated	Straight Hourly	Time and Half	a Double Time	Overtime Provision	
Name	Description						
=====							
Underground Laborer Open Cut, Class VII							
Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes, flagstones etc.	LAUC-Z1-7		\$32.09	\$39.99	\$47.88	X X X X X X D Y	

9/5/2013

Apprentice Rates:

0-1,000 work hours	\$28.72	\$34.93	\$41.14
1,001-2,000 work hours	\$29.39	\$35.93	\$42.48
2,001-3,000 work hours	\$30.07	\$36.95	\$43.84
3,001-4,000 work hours	\$31.42	\$38.98	\$46.54

Official Request #: 98

Requestor: Troy School District

Project Description: Larson Middle School Office Renovation, International Academy

Project Number: Bid Package 19, BID 9834

County: Oakland

Official Rate Schedule

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

SECTION 00880
REGULATORY REQUIREMENTS

1. STANDARDS, CODES AND REGULATION

- 1.1. All Work is to comply with the rules and regulations of governing bodies having jurisdiction.
- 1.2. Standards, codes and regulations published by Manufacturer's associations, governmental agencies and other regulatory authorities form a part of these Specifications as minimum requirements. Such references include the latest issue and legal requirements in force.
- 1.3. Where differences occur between the Contract Documents and such standards, the strictest requirements shall take precedence.
- 1.4. Supply all materials and perform all Work in accordance with the Manufacturer's specifications and installation procedures, and in conformance with published Trade and Manufacturers' association standards, unless specifically noted otherwise in the Contract Documents.

2. PERMITS AND FEES

- 2.1. The Troy School District will obtain and pay for the General Building Permit.
- 2.2. Other than the general building permit, Contractor shall provide and pay for all other permits, assessments, governmental fees, bonds, connection charges, licenses and inspection fees and any other charges necessary for the proper execution and completion of the Contractor's Work.
- 2.3. Contractor is to provide, pay for and coordinate all other permits, fees, inspections, and city, county, state, federal and governing authority approvals required for the successful completion of the Work contained within its respective Bid Category and deliver required certificates of inspection and approvals to CM.
- 2.4. This Project is under but not limited to the jurisdiction of the
 - MICHIGAN DEPARTMENT OF LABOR FOR MECHANICAL AND ELECTRICAL
 - STATE OF MICHIGAN FIRE MARSHAL DIVISION
 - MICHIGAN DEPARTMENT OF PUBLIC AND (COUNTY) DEPARTMENT OF PUBLIC HEALTH
 - Site water and sewer utilities are under the jurisdiction of the COUNTY DRAIN/ROAD COMMISSION authorities

3. TAXES

- 3.1. This Project is subject to all applicable state Sales Tax and/or Use taxes, and Bidder must include such taxes in its Bid Proposal. All other taxes applicable to the project at the time of the bid are to be included in the bid amount and will be the responsibility of Bidder.

END OF SECTION 00880

SECTION 01140
USE OF PREMISES

1 RULES AND ENFORCEMENT:

- 1.1. Contractor and its Subordinate Parties shall be subject to rules and regulations for the conduct of the Work as stated herein and as the Owner or CM may establish.
- 1.2. Willful disregard of the following will be grounds for requiring the offending person(s) to be removed from the Project, and may subject the Contractor to termination under the Agreement.

2 USE OF PREMISES AND DELIVERIES

2.1. ACCESS TO WORK:

- 2.1.1. Before starting the Work, Contractor shall ascertain from CM what entrances, routes or roadways shall be used for access to the Work, and use only those designated for movement of personnel, materials and vehicles to and from the Project site.
- 2.1.2. Close coordination is required of Contractor with the Owner, CM, other contractors, the city and others having an interest in the Project to assure that Work on the site, access to and from the site and the general conduct of operations is maintained in a safe and efficient manner, and that disruption and inconvenience to existing streets and property is minimized.
- 2.1.3. Contractor is responsible to review the site and be familiar with all existing conditions within and around the Owner's property including local conditions and requirements.

2.2. ENTRANCES AND DRIVES

- 2.2.1. Specific entrances for material deliveries, equipment deliveries and worker access to the Project site will be as designated/directed by CM.
- 2.2.2. Selected entrances to the Project site will remain open for use during normal working hours.
- 2.2.3. At no time are vehicles to be parked, whether attended or not, in the Owner's entrances or drives.
- 2.2.4. Any material delivery which will tie up the Owner's entrances or drives shall be pre-scheduled with the Owner through CM.
- 2.2.5. Owner's deliveries and operations will take precedence over scheduling of construction deliveries.

2.3. ACCESS TO BUILDINGS:

- 2.3.1. Maintain free access to all buildings and areas of the site for designated vehicles, service vehicles and firefighting equipment, and at no time shall block off or close roadways or fire lanes without providing auxiliary roadways and means of entrance acceptable to the Owner and CM.
- 2.3.2. Maintain a clean and safe passageway for the Owner's operations and personnel in existing areas, and maintain clearances adjacent to and in connection with the Work performed. Fire hydrants must remain accessible at all times.
- 2.3.3. Give the Owner and the local fire department at least forty-eight (48) hours' notice of any such changes of routes.

2.4. SITE PARKING:

- 2.4.1. There is on-site parking for Contractors and their Subordinate Parties' employees.
- 2.4.2. Contractor, Subordinate Parties and their personnel will be allowed to park in the Owner's parking area. Each Contractor is responsible for providing transportation to and from the site, if required.

- 2.5. **LOADING OF STRUCTURE:** Each Contractor on behalf of itself and its Subordinate Parties shall not load or permit any part of a structure to be loaded with a weight that will endanger its safety.
- 2.6. **USE OF OWNER'S EQUIPMENT:** Contractors and their Subordinate Parties will not be allowed to use any Owner tools or equipment during the course of the Project.
- 2.7. **USE OF EXISTING ELEVATORS**
 - 2.7.1. Contractor may subject to the approval of CM and Owner, use the existing elevator(s) designated by the Owner within the contract boundaries for movement of personnel and materials to a construction area.
 - 2.7.2. In those cases where an elevator is to be shared with Owner services, the Owner's employees and services take priority over construction activities.
 - 2.7.3. Contractor is responsible for proper conduct with regard to the use of the elevator. Any damage to the elevator due to oversize load, excess weight or other conditions is the individual Contractor's responsibility.
 - 2.7.4. Use of the elevator(s) at times other than normal working hours shall be coordinated with CM and Owner.
- 2.8. **USE OF EXISTING FACILITIES**
 - 2.8.1. Limit the usage of the occupied areas of the facility to that which is absolutely necessary for the installation of the Work. Parts of the facility not in the construction area are "off limits" unless a specific work task is being performed as designated by CM.
 - 2.8.2. Use of the Owner's cafeteria, parking, telephones, toilet facilities, tools, equipment, or any other item or facility belonging to the Owner is not allowed unless specifically authorized by Owner and CM.
 - 2.8.3. Restrict all Work activities associated within an area undergoing renovation to the boundaries indicated by the Contract Documents. Any means of access or egress from the stipulated boundaries shall be coordinated with CM and the Owner.
- 3 **WORK HOURS:**
 - 3.1. Normal working hours are; 7:00 AM to 3:30 PM, Monday through Friday.
 - 3.2. Work operations shall comply with all applicable laws, ordinances, and regulations, and not create a public nuisance nor disturb the peace.
 - 3.3. Compensation to CM for supervisory staff due to abnormal working hours will be at the requesting Contractor's expense.
 - 3.4. Whenever Contractor intends to depart from normal work hours, it shall notify CM in writing at least forty-eight (48) hours in advance. Failure of Contractor to give such timely notice may result in CM directing the removal or uncovering of the Work performed during such abnormal hours at Contractor's expense. Special arrangements can be made for emergency work or shutdowns as may be required.
 - 3.5. Required off-hours work:
 - 3.5.1. Contractors may be requested to work split shifts, weekends, off peak Owner loading periods, etc., to accommodate Owner's utility and service requirements, such as, but not limited to, medical gas systems, electrical power, HVAC systems, storm and sanitary lines.
 - 3.5.2. All Work shall be bid on a straight time basis. Should premium time be required by the Owner, the cost for premium time labor, which may be required, is the Contractor's responsibility and is to be included in the base bid.
- 4 **USE OF EXPLOSIVES:** Is NOT permitted.
- 5 **DUST, DIRT, NOISE:** Each Contractor shall effectively confine or eliminate dust, dirt and noise to the actual construction area and in compliance with all applicable laws, rules and regulations.

6 **BEHAVIOR AND CONDUCT:** The Owner and CM expect Contractors and their Subordinate Parties to exercise common sense and good judgment, and to conduct themselves in a manner which would be a credit to the Owner. Without limiting other applicable provisions of the Contract Documents, Contractor shall not engage in the following:

- 6.1. Conduct that interferes with Work or work of others.
- 6.2. Conduct that interferes with or is detrimental to safety, well-being of the owner, their operations and/or good reputation.
- 6.3. Unauthorized use of confidential information.
- 6.4. Discourtesy toward Owner's staff, visitors and the general public (including abusive, vulgar or other language.)
- 6.5. Soliciting, canvassing, posting, or distributing literature or materials for any purpose while on the job site.
- 6.6. Disregard of safety, sanitation, or security laws, rules and regulations.
- 6.7. Stealing.
- 6.8. Gambling.
- 6.9. Possession and/or use of narcotics or intoxicants.
- 6.10. Threats or abuse of others.
- 6.11. Disorderly conduct or fighting.
- 6.12. Playing of loud music.
- 6.13. Falsification of information.
- 6.14. Unauthorized travel of Contractor's employees outside the designated project Work areas.
- 6.15. Discriminating behavior.
- 6.16. Possession and/or use of weapons or firearms.
- 6.17. Sexual or Ethnic harassment.
- 6.18. Smoking: Contractors and their Subordinate Parties shall be responsible for adhering to the smoking policies and regulations of the Owner and the Owner's facilities.

7 **TEMPORARY PARTITIONS:**

- 7.1. Partition construction shall provide a fire-resistant classification approved by the authorities having jurisdiction. Openings in such partitions shall be protected by fire doors consistent with the rating of the partition. Any trade creating penetrations through the temporary partitions shall fire stop openings to match the rating of the wall.

8 **PROTECTION OF FACILITIES**

- 8.1. Each Contractor on behalf of itself and its Subordinate Parties shall be responsible for all damage to the Project including the existing buildings and grounds arising or resulting from its operations under the Agreement. Repair or replacement of damaged items shall be to the satisfaction of the Owner and CM.
- 8.2. Each Contractor shall provide and maintain proper shoring and bracing for existing underground and aboveground utilities, foundations, structure and systems encountered during its Work and shall
 - 8.2.1. protect the project, or any part thereof, and surrounding areas from collapse or movement, or any other type of damage until such time as they are to be removed, incorporated into the new Work or can be properly supported or backfilled upon completion of new Work.
 - 8.2.2. limit disruptions to a maximum of four (4) hours.

- 8.2.3. prior to beginning any Work that may affect underground facilities, contact MISS DIG and utility companies for the location of all existing underground services.
 - 8.2.3.1. Provide documentation of such contact to CM.
 - 8.2.3.2. If necessary, Contractor shall pay for layout and locating of existing utilities.
 - 8.3. Utilities and/or other services which are shown, or not shown but encountered, shall be protected by the Contractor from any damage arising or resulting from Work, unless or until they are abandoned. If the utilities or services are damaged from Contractor's Work, Contractor shall immediately repair any damage and restore the utilities and services to an equal or better condition than that which existed prior to the damage. Contractor will be responsible for all liabilities, expenses, lawsuits or claims arising or resulting from such damage and will defend, hold harmless and indemnify Owner and CM from any claims or lawsuits or other expenses.
 - 8.4. Each Contractor on behalf of itself and its Subordinate Parties shall be responsible for all damage to the Project and surrounding areas including the existing building and grounds arising out of or resulting from their performance of the Work. Repair or replacement of damaged items shall be to the satisfaction of the Owner and CM.
 - 8.5. Preservation of existing trees and other vegetation on the site to the maximum extent possible is required.
 - 8.5.1. Each Contractor must plan its Work and instruct its Subordinate Parties to conduct their operations to avoid damage to trees and vegetation (provide barriers as required.)
 - 8.5.2. Indiscriminate driving about the site, disposing of waste, storage of materials upon or against trees or any other activity which is harmful to trees or vegetation will not be tolerated.
 - 8.5.3. Any case of damage to any tree shall be reported to CM immediately so that professional repairs can be made. The cost of such required repairs or treatment shall be charged to the responsible Contractor.
- 9 OWNER'S OPERATIONS & INTERRUPTION OF OCCUPANCY /SEQUENCING
- 9.1. The Owner shall have the option to curtail or delay any activity that affects its operations. Should a Contractor be asked to stop its Work, the Contractor shall do so immediately and proceed with other activities with no additional cost to the Owner or CM.
 - 9.2. The Owner may occupy the premises during the entire period of construction to conduct operations.
 - 9.3. Each Contractor is responsible to plan, coordinate and execute its Work in such a manner that there will be no disruption of or the least disruption to the Owner's operations. If an interruption of operations is unavoidable, then this Work will be scheduled with the Owner through CM.
 - 9.4. Contractors is responsible to provide temporary utilities and systems to maintain services to the facility while Work is being performed.
 - 9.5. No interruptions to Owner's power, lighting, signal, or alarm circuits will be permitted without the express written permission of the Owner through CM. Arrangements for interruptions shall be made with the Owner at least forty-eight (48) hours prior to the interruption and shall be made at such time and duration as authorized by them. Temporary feeders, transformer jumpers, connections, circuits, etc., shall be used as required to accomplish the above at no additional cost to the Owner and CM.
- 10 MATERIAL STORAGE
- 10.1. All Contractors are required to provide and pay for off-site storage facilities as required for their Work.
 - 10.2. All Contractors will not be allowed on-site storage facilities. Material, equipment and tools, shall not be stored on-site in excess of five (5) working days prior to installation or use without CM's approval.
 - 10.3. Storage of combustible materials within or adjacent to the building is prohibited.
 - 10.4. All Contractors shall

- 10.4.1. Stock the job with sufficient materials to maintain progress and schedule and without interfering with the Work or storage of others.
- 10.4.2. Assume full responsibility for the protection and safekeeping of products under their control which are stored on the site.
- 10.4.3. Move any stored products under their control, which interfere with operations of the Owner or separate contractors as directed by CM.
- 10.4.4. Provide sufficient protection for its materials and equipment from damages by weather or construction work or other hazards.
- 10.4.5. Remove all debris and leave the area in a clean and orderly condition during progress of Work and upon completion of the Work.
- 10.4.6. Submit a receipt of shipment for all equipment stored on-site or off-site to CM. No materials or equipment shall be removed from the site without the permission of CM

END OF SECTION 01140

SECTION 01250 CHANGES IN THE WORK

1 SUMMARY

- 1.1 This section describes the following requirements including:
 - 1.1.1 Types of Change Documentation
 - 1.1.1.1 PCO – Potential Change Order
 - 1.1.1.2 CO – Change Order
 - 1.1.2 Compensation of Overhead and Profit for Changes in the Work
 - 1.1.3 Itemization of Cost of Changed Work
- 1.2 This section is not intended to include RFI's, ASI's (Architects Supplemental Instructions), or other documents that clarify the work but have no substantive cost or schedule impact to the work.

2 TYPES OF CHANGE DOCUMENTATION

Changes to the work which may involve a change in the contract price or schedule will be accompanied by the Barton Malow form entitled "PCO- Quotation Only". In the event that the timing does not allow the For Quote Only process, then CM will issue its form entitled "PCO-Notice to Proceed."

2.1. PCO- NOTICE TO PROCEED AND FOR PCO- QUOTATION ONLY FORMS

- 2.1.1. A PCO- Notice to Proceed is used when Work must be performed with swiftness and authorization to proceed by Change Order is inappropriate due to time restrictions. In order for a PCO- Notice to Proceed to be valid, it must be signed by CM. The terms for establishing the additional cost and processing of the PCO- Notice to Proceed into a Change Order shall be identified prior to its release by CM.
- 2.1.2. If a change results in a change in cost, CM will issue a PCO with the supporting change documents.
- 2.1.3. Contractor shall prepare a detailed cost quotation for the PCO. This quotation shall include an itemized takeoff of labor, equipment and material with a unit cost for each item together with backup and breakdown documentations satisfactory to CM. The PCO must be returned as directed
- 2.1.4. Contractor shall sign and date the PCO and submit it with proper backup. The PCO will then be reviewed, evaluated, negotiated and then, when acceptable, processed
- 2.1.5. The PCO- Quotation Only is a document used for processing Contractor's quotations and is **not** a Change Order. Therefore, completion of the PCO- Quotation Only does **not** release the Work to begin.
- 2.1.6. PCO's will precede a Change Order. Contractors shall receive an approved PCO- Notice to Proceed or an executed Change Order before starting Work. Any changed Work performed by Contractor without a properly executed PCO- Notice to Proceed or a properly executed Change Order is at Contractor's sole risk and expense. BILLINGS AGAINST CHANGES WILL NOT BE ACCEPTED AFTER A PCO- NOTICE TO PROCEED OR FOR QUOTE ONLY IS ISSUED, BUT ONLY AFTER A CHANGE ORDER HAS BEEN PROCESSED AND SIGNED BY ALL PARTIES.

2.2. CHANGE ORDER

- 2.2.1. Change Orders will be issued by CM. CM will first issue the Change Order to the Contractor for signature. The Change Order will then be returned to CM. Once all appropriate signatures are secured, an executed copy will be sent to the Contractor.
- 2.2.2. Once the Change Order has been processed and signed by all parties, the Contractor may invoice for payment on the completed portion of Work.
- 2.2.3. Agreement on a Change Order shall constitute a final settlement of all matters relating to the changed Work that is the subject of the Change Order.

3. COMPENSATION OF OVERHEAD AND PROFIT FOR CHANGES IN THE WORK

3.1. CONTRACTOR'S OVERHEAD AND PROFIT

- 3.1.1. For changes resulting in increase of cost:
 - 3.1.1.1. Overhead and profit for the Contractor shall not exceed the following when change Work is performed by
 - 3.1.1.1.1. Contractor itself: fifteen percent (15%).
 - 3.1.1.1.2. Contractor subordinate party: five percent (5%)
 - 3.1.1.2. Overhead and profit for the subordinate party shall not exceed the following when change Work is performed by
 - 3.1.1.2.1. Subordinate party itself: fifteen percent (15%)
 - 3.1.1.2.2. Contractor to the subordinate party: five percent (5%)
- 3.1.2. For changes resulting in reduction of cost
 - 3.1.2.1. Deductive costs shall include commensurate deductive credits for overhead and profit based on the percentages stated above.
- 3.1.3. Contractor's and Subordinate Party's overhead and profit shall include cost (at the Project Site, home office and otherwise) of supervision, telephone, travel, copying, administrative services, office, power, light, tools, jobsite vehicles, and all other general expenses including bond premiums. In no event shall these items be charged as cost of the Changed Work.

4. ITEMIZATION OF COST OF CHANGED WORK

4.1. EXTRA WORK TICKETS

- 4.1.1. If extra work is to be completed above and beyond the terms of the contract, as determined by (and approved in advance by) the CM, the Contractor is required to:
 - 4.1.1.1. Provide an Extra Work Order ticket to the CM within three (3) days of completing the work.
 - 4.1.1.1.1. Extra Work Order tickets will be rejected if they are not turned in to the CM within three (3) days of completing the work.
 - 4.1.1.1.2. Extra Work Order tickets are to be completed in triplicate and a copy is to be left with the CM.
 - 4.1.1.1.2.1. The CM will sign all copies of the Extra Work Order tickets and return two (2) to the Contractor in a prompt manner, keeping one for record.
 - 4.1.1.1.3. A copy of the signed ticket(s) must accompany the Request for Change Order(s) quote from the Contractor. A change order will not be processed and the Request for Change Order(s) will be rejected if there is no signature from the CM.

4.1.1.2. Provide the CM with a Request for Change Order for the extra work within ten (10) days of receiving the signed ticket.

4.1.1.2.1. The Request for Change Order must be accompanied by a copy of the signed Extra Work Order ticket from the Contractor.

4.1.1.2.2. The Request for Change Order will be rejected and no PCO or Change Order will not be processed if the quote is not received within ten (10) days of the date signed by the CM.

4.2. CORRELATION WITH CONTRACTOR'S SUBMITTALS

4.2.1. Contractors shall

4.2.1.1. Revise the Schedule of Values and Request for Payment forms to record each Change Order as a separate item of Work, and to record the adjusted contract price.

4.2.1.2. Revise the Construction Schedule to reflect each change in Contract Time approved by a Change Order.

4.2.1.3. Revise sub-schedules to show changes for other items of Work affected by the changes.

4.2.1.4. Enter and revise Record Documents to reflect changes

4.3. COST OF THE CHANGED WORK

4.3.1. The "Cost of the Changed Work" shall be approved by CM and shall mean the costs necessarily incurred by the Contractor in the proper performance of the Changed Work. Such rates shall not be higher than those customarily paid at the place of the Project. The Cost of the Changed Work shall only include those items set forth below.

WAGES OF LABOR	Wages of construction workers directly employed by Contractor to perform the construction of the changed Work at the site
PAYROLL MARKUP	The amount approved by CM and Owner which covers the costs paid by the Contractor for taxes, insurance, contributions, assessments, and benefits required by law or collective bargaining agreements and for personnel not covered by such agreements, customary benefits such as sick leave, medical and health benefits, holidays vacations and pensions, provided that such costs are based on the wages and salaries of labor performing the changed Work.
COST OF EQUIPMENT, MATERIALS, AND SUPPLIES	Costs of materials, equipment and supplies to be incorporated into the changed Work less all savings, discounts, rebates and credits accruing to the Contractor.
RENTAL CHARGES FOR EQUIPMENT NOT OWNED BY CONTRACTOR	Rental charges for equipment not owned by Contractor that is necessary for completion of the Changed Work. Rates and quantities rented must be approved in advance by CM.
TAXES	Sales or use taxes imposed by a governmental authority which are directly attributable to the changed Work and for which the Contractor is liable.
SUBORDINATE PARTY COSTS	Payments made to the Contractors for proper execution of Changed Work, subject to the limits set forth above for overhead and profit.

4.2.2. In no event shall the Cost of Changed Work include:

- 4.2.2.1. Salaries or wages of persons other than those directly performing the changed Work, including Contractor's personnel stationed at the principal office;
- 4.2.2.2. Expenses of the Contractor's principal office and offices other than the site office, except as provided above;
- 4.2.2.3. Overhead and general expenses of any nature, except as set forth above;
- 4.2.2.4. Capital expenses of Contractor, including interest on the Contractor's capital employed for the Changed Work;
- 4.2.2.5. Rental costs for machinery or equipment, except as allowed above, or tools of any kind, unless specifically identified and approved in advance in writing by CM;
- 4.2.2.6. Costs due to the negligence or failure to perform of the Contractor or its Subordinate Parties;
- 4.2.2.7. Costs designated above as being included in Overhead and Profit
- 4.2.2.8. Any cost not specifically described above, or otherwise approved in advance and in writing by CM and Owner.
- 4.2.2.9.** Any bond premiums of portion of increased bond costs directly attributable to the changed Work.

4.3. QUOTATION FORMAT

Based on the above, the following formula will be utilized by all of the Contractors.

Number of PCO _____
 Date of PCO _____
 Description of Change _____

Cost of Changed Work

Labor:

Carpenter	(No. of Hrs. x Rate)	xxx.xx	
Labor	(No. of Hrs. x Rate)	xxx.xx	
Ironworker	(No. of Hrs. x Rate)	<u>xxx.xx</u>	
Subtotal			xxx.xx
OH&P @ 15%			xxx.xx

Equipment, Materials, Supplies:

Ace Hardware	xxx.xx		
Acme Products	xxx.xx		
Concrete Supplier		<u>xxx.xx</u>	
		xxx.xx	
Subtotal			xxx.xx
OH&P @ 15 %			<u>xxx.xx</u>
Subtotal (1)			xxx.xx

Contractor Costs

ABC Welding	xxx.xx		
XYZ Resteel		<u>xxx.xx</u>	
Subtotal			xxx.xx
OH&P @ 5 %			<u>xxx.xx</u>
Subtotal (2)			xxx.xx

TOTAL QUOTATION AMOUNT

Total Quotation (Subtotal 1 plus Subtotal 2)

XXX.XX

END OF SECTION 01250

SECTION 01290 PAYMENT PROCEDURES

1. SUMMARY

1.1. This Section describes the following requirements including:

- 1.1.1. Schedule of Values
- 1.1.2. Application for Payment Process
- 1.1.3. Reduction of Retention
- 1.1.4. Payment for Materials Stored Off-site
- 1.1.5. Waivers of Lien and Sworn Statements

2. PAYMENT PROCEDURES

2.1. SCHEDULE OF VALUES

- 2.1.1. Once the Agreement is awarded, each Contractor must submit a Schedule of Values for its entire Work to CM for approval. This Schedule of Values must be submitted either within fifteen (15) days of award or fifteen (15) days prior to the first payment application deadline (per the Application for Payment Schedule), whichever comes first. The Schedule of Values must include labor and material line items for each portion of the Work (larger portions of Work such as concrete, curtainwall, drywall, mechanical, and electrical shall be broken down by elevation, floor, and areas appropriate), the Contractor shall separate bond costs, and general conditions line items as appropriate.
- 2.1.2. The Schedule of Values will be submitted in a format as prescribed by, and to the level of detail specified by, CM.
 - 2.1.2.1. The sum of the parts of the Schedule of Values shall equal the contract price.
 - 2.1.2.2. The minimum level of breakdown and order on the application for payment will be:
 - 2.1.2.2.1. Bond costs, if applicable
 - 2.1.2.2.2. General conditions line item(s)
 - 2.1.2.2.3. Division 1 cost breakdown as required
 - 2.1.2.2.4. Costs associated with preparation of closeout paperwork and documentation
 - 2.1.2.2.5. Major portions of the Work shall be broken down into labor and material line items for specific areas of the facility
 - 2.1.2.2.6. A listing of approved and executed Change Orders to the Contract, if any, in sequential order.
 - 2.1.2.3. Schedule of Values items shall have a direct and understandable relation to the Project master construction schedule.
 - 2.1.2.4. Overhead and profit shall be listed as a separate line item on the schedule of values.
- 2.1.3. The Schedule of Values, unless objected to by CM, Owner or Architect, shall be the basis for the Contractor's application for payments.
- 2.1.4. CM shall have the right to require the Contractor to alter the value or add/delete categories listed on the Schedule of Values at any time for the following reasons:
 - 2.1.4.1. The Schedule of Values appears to be incorrect or unbalanced.

- 2.1.4.2. A revision of the Schedule of Values is required due to the Contractor revising the sequence of construction or assembly of building components that in turn invalidates the Schedule of Values.
- 2.1.4.3. Change Orders are issued to the Contractor and shall be incorporated into the Schedule of Values as a separate line item at the bottom of the Schedule of Values.
- 2.1.5. The Contractor is required to correlate the documentation for payment of stored materials requested in the application for payment against the agreed upon breakdown of the Schedule of Values as described in Payment for Stored Materials. CM reserves the right to not process the application for payment if this correlation has not been submitted in conjunction with the application.

2.2. APPLICATION FOR PAYMENT PROCESS

2.2.1. Step 1: JOB-SITE INSPECTION - DRAFT PAYMENT REQUEST

- 2.2.1.1. The Contractor shall
 - 2.2.1.1.1. have a representative walk the Project site with CM's representative on or before the tenth (10th) of the month,
 - 2.2.1.1.2. invoice for Work from the tenth (10th) of last month to the tenth (10th) of the present month.
 - 2.2.1.1.3. submit during the review, the itemized rough draft of the Application and Certificate for Payment (AIA Documents G702 and G703 Continuation Sheet) identifying the Work completed, if any, during the current calendar month; shall review same with CM and obtain a preliminary approved copy of the draft for official submission
 - 2.2.1.1.4. Contractor's pay application shall only reflect Work completed through the date of submission. In no event will payments be authorized for forecasted Work.

NOTE: No payment shall be issued to a Contractor for materials stored off-site unless supported by proper documentation as required by CM (upon advance notification of such requests only) as described in Part 3 Payment for Stored Materials.

2.2.2. Step 2: PAYMENT REQUEST PREPARATION/SUBMISSION

- 2.2.2.1. With the information agreed upon in Step 1, the Contractor will prepare a formal application for payment request.
- 2.2.2.2. Final electronic copies are due to CM on or before the fifteenth (15th) of the month.
- 2.2.2.3. Late or incomplete application packets will not be accepted.**
- 2.2.2.4. The payment request will be made on an Application and Certificate for Payment form (AIA documents G702 and G703).
- 2.2.2.5. Before submitting these documents to CM, each request for payment must be signed by a duly authorized agent of the Contractor and notarized.
- 2.2.2.6. The Contractor must include with each request for progress payment a waiver of lien for all previous payments, Contractor's sworn statement and any necessary backup data as described in Part 4, Waivers of Lien and Sworn Statements.
- 2.2.2.7. In addition, at submission of the final pay application Contractor shall provide unconditional final waivers of lien for all Subordinate Parties, as well as all close out documentation and all additional back up data described in Part 4, Waivers of Lien and Sworn Statements.
- 2.2.2.8. In requests for payment which follow the execution of a Change Order in excess of twenty-five percent (25%) of the Agreement price, Contractor must present a bond

rider evidencing that the penal sum of any required payment and performance bonds have been increased to one hundred percent (100%) of the adjusted Agreement price, or such other percentage as set forth in Section 00200 of the Project Manual, Instructions to Bidders. Submission of the required back-up data is a condition precedent to payment.

2.2.3. Step 3: CHECK DISTRIBUTION

2.2.3.1. CM will issue individual checks to each Contractor. The Contractor will receive the waiver of lien with the check and will be required to sign three (3) originals of the waiver upon receipt of the check each month (see Part 4).

2.2.3.2. The Contractor shall provide all supporting documentation substantiating the Contractor's right to payment as the Owner, CM and the Architect may require.

2.3. REDUCTION OF RETENTION

2.3.1. CM shall be entitled to withhold ten (10%) percent of each payment due to a Contractor until Substantial Completion of the Contractor's Work.

2.3.2. The Contractor, when requesting a reduction of retention, shall submit to CM, an AIA G707, Consent of Surety to Reduction In or Partial Release of Retention form in Section 01600 Forms.

2.3.3. Within thirty (30) days after Certificate of Substantial Completion has been issued for all portions of its Work, the Contractor's retention may be reduced to a sum as CM/the Architect may determine is suitable to protect CM and the Owner for all incomplete Work and any unsettled claims.

2.3.4. Notwithstanding the foregoing, payment of retention shall be subject to all other conditions precedent that applies to payment as set forth in the Contract Documents.

3. PAYMENT FOR MATERIALS STORED OFF-SITE

3.1. PAYMENT FOR MATERIALS STORED OFF-SITE

3.1.1. The Contractor, if intending to use an off-site storage area or facility for stored materials, shall submit a written request to the CM and obtain approval prior to submitting the first application for payment as described in Part 2 Applications for Payment.

3.1.2. Payments will be made for materials properly stored off site.

3.1.2.1. "Properly stored" shall mean in an insured warehouse with the Owner and CM being named as insureds, and all material identified as property of the Owner.

3.1.2.2. The Contractor is responsible for all associated off site storage costs, transportation, insurance, including insurance coverage for stored material, while in transit, unless Contractor obtains written documentation that the material is covered during transit under a Builder's Risk Policy applicable to the Project.

3.1.2.3. Contractor shall provide CM and the Owner verification in writing for all material so stored. Such materials shall be protected from diversion, destruction, theft, and damage to the satisfaction of CM, Owner and the Lender (if any), specifically marked for use on the Project, and segregated from other materials at the storage facility.

3.1.2.4. The Contractor bears all risk of loss to materials and equipment stored off site.

3.1.3. Contractor is to provide supporting documentation in the form of invoices, insurance policies, and any other pertinent documentation as requested by CM or Owner for items the items stored off-site. Documentation shall include the following:

3.1.3.1. Detailed description of the material including quantities that will serve as a material description for the billing and as information to file a claim with an insurance company.

- 3.1.3.1.1. Stored Materials - Each item must be identified as to manufacturer, model number, and serial number, if applicable, or other identifiers should be listed for each item. Each listing must be accompanied by invoices, shipping tickets, consent of surety, and any other applicable supporting documentation.
- 3.1.3.1.2. Stored Manufactured Building Materials - Each item must be identified as to type, manufacturer's number or designation, and should also list the number of cartons and the contents therein storage. Each listing must also be accompanied by supporting documents including all invoices, shipping tickets and consent of surety.
- 3.1.3.1.3. Stored Fabricated Materials - A listing specifying the number of pieces, items, and marks as may be applicable to the particular type of items. Photographs should accompany the request.
- 3.1.3.2. Individual itemized costs of materials and the total cost value, which shall not exceed the Contractor's subcontractor or material supplier cost. The total cost value shall be supported by the Contractor's subcontractor or material supplier invoices for the stored material.
- 3.1.3.3. Estimated cost value for those materials that are fabricated by the Contractor's subcontractor or material supplier.
- 3.1.3.4. The location where the material is physically stored, including the warehouse address and storage location within the warehouse, such as bin number, aisle number or other designation. All material shall be segregated and marked.
- 3.1.3.5. Copies of the insurance policies that cover the stored materials and that name CM and the Owner as insureds. The limit of the insurance policy shall be equal to or greater than the replacement value of the stored materials.
- 3.1.4. When Applications for Payment include products stored off the Project Site or stored on the Project Site but not incorporated in the Project, for which no previous payment has been requested, a complete description of such product shall be attached to the application.
- 3.1.5. Contractor shall submit a certificate of title listing the Owner's ownership in the off-site stored materials equal to the amount paid effective at the time funds are delivered.
- 3.1.6. If the size, quantity, and/or type of material or product is such that a bonded warehouse is deemed unsuitable, then, with CM's approval, the Contractor may elect to prepay its subcontractor or supplier for certain material and products which are to remain on and be stored on that subcontractor/supplier's premises until needed by the Project. In such event, the Contractor shall enter into a security agreement with the subcontractor/supplier under which the Contractor shall be granted a security interest in and to all such material and products fabricated and/or to be supplied by the subcontractor/supplier for this Project and stored on the subcontractor/supplier's premises. This Security Agreement shall be a part of the financing statement, which shall be presented to a filing officer for filing pursuant to the Uniform Commercial Code. All expenses incurred in obtaining this security agreement shall be at Contractor's sole cost and expenses, and shall not accrue to the Owner, CM, Architect, nor the Project. A copy of each and every security agreement shall be filed with CM with the first Application for Payment which requests payment for such material or products.
- 3.1.7. All payment requests for off-site stored materials must be accompanied using the "Payment Request for Stored Materials" and a "Subcontractor Affidavit for Stored Materials." Payment requests for stored materials not complying with the foregoing requirements will not be approved. Contractors are to notify the CM in ample time to conduct verification procedures.
- 3.1.8. Contractors may not apply the cost of materials stored off-site towards a reduction in the retention amount.

- 3.1.9. Representatives of CM and Owner shall have the right to make inspections of the storage areas at any time.

4. WAIVERS OF LIEN AND SWORN STATEMENTS

4.1. WAIVERS OF LIEN

- 4.1.1. The Contractor's first Application for Payment will be based upon 100 percent of the value of Work installed. The first payment, amounting up to 90 percent of application, will be made to the Contractor without supporting documentation. Subsequent Applications for Payment must be accompanied by lien waivers from the Contractor, its Subordinate Parties or receipted invoices covering payment to the Contractor for previous calendar month period. Lien waivers must be unconditional and must show the amount paid.
- 4.1.2. An "Acknowledgment of Payment and Partial Unconditional Release" will be distributed with the check to each Contractor by CM for payment of the previous month's application. The Waiver of Lien is to be signed by an authorized representative of the Contractor. Under no circumstances will payment be released until the completed "Acknowledgment of Payment and Partial Unconditional Release" has been submitted and signed by the Contractor from the previous month.
- 4.1.3. Final payment will not be made until a "Final Release Subcontractor/Materialman has been submitted. This will also be distributed by the CM for Contractor signature and must be returned by the Contractor. The Final Release must be signed by an authorized representative of the Contractor and must be notarized.
- 4.1.4. Final unconditional waivers will be required for all of Contractor's Subordinate Parties listed on Contractor's sworn statement. These final waivers must be submitted along with the final release, before payment can be made.

4.2. SWORN STATEMENTS

- 4.2.1. The appropriate number of original "Sworn Statements" must be completed to the satisfaction of CM, signed and notarized by an authorized representative of the Contractor and submitted with the Contractor's Application for Payment, monthly to the CM.
- 4.2.2. The Contractor's Subcontractor's sworn statements, waivers and other supporting documentation will be required with each pay application.

END OF SECTION 01290

SECTION 01310 MEETINGS

1. GENERAL

1.1. DESCRIPTION OF REQUIREMENTS

- 1.1.1. The CM shall schedule, chair, and administer all periodic meetings throughout the progress of the work for the purpose of coordinating and expediting the Work. Such meetings shall be held at the job site bringing together responsible representatives of active Contractors for the purpose of planning, assessing progress and discussing problems of mutual concern. Each Contractor, and its Subordinate Parties' representative attending the meetings shall be authorized to act on behalf of and make decisions/commitments for the entity each represents, the decisions made at the meetings and each Contractor who should be in attendance will be held responsible for information and directions given at the meeting.
- 1.1.2. The CM will prepare and distribute the minutes of all meetings, if CM determines minutes are required. If the attendees do not object in writing to any part of the meetings within ten (10) days of distribution of the minutes, the minutes shall be accepted as written.
- 1.1.3. The scope of meetings include, but are not limited to:
 - 1.1.3.1. Preconstruction Meeting
 - 1.1.3.2. Job Progress/Coordination Meetings
 - 1.1.3.3. Other Meetings

2. TYPES OF MEETINGS

2.1. PRECONSTRUCTION MEETING (KICK-OFF)

- 2.1.1. A Preconstruction (kick-off) meeting will be conducted with representatives of all the Contractors within fifteen (15) days after the Agreement is awarded at the jobsite or as designated by the CM. The agenda may include:
 - 2.1.1.1. Discussion on major subcontracts and suppliers
 - 2.1.1.2. Major and/or critical work sequencing regarding the project schedule
 - 2.1.1.3. Project coordination and designation of responsible personnel
 - 2.1.1.4. Procedures and processing of field instructions, requests for proposal, submittals, change orders, applications for payment, etc.
 - 2.1.1.5. Quality assurance/control issues
 - 2.1.1.6. Adequacy of distribution of contract documents
 - 2.1.1.7. Procedures for maintaining record documents
 - 2.1.1.8. Use of premises, office, work and storage areas and other CM requirements
 - 2.1.1.9. Construction facilities/temporary utilities
 - 2.1.1.10. Safety and security procedures
 - 2.1.1.11. Other administrative procedures
 - 2.1.1.12. Review of Owner expectations

2.2. JOB PROGRESS/COORDINATION MEETINGS

- 2.2.1. On-site project coordination/progress meetings will be held on a bi-weekly basis or as appropriate throughout the life of the Project. The [CM/Owner] will set the agenda for the Project progress meeting. At a minimum, each Contractor shall be prepared to discuss the following:
 - 2.2.1.1. Actual vs. scheduled progress for the prior two-week period

- 2.2.1.2. Planned construction activities for the next four weeks
- 2.2.1.3. Problems with, revisions to and corrective measures and procedures to regain the construction schedule, if required
- 2.2.1.4. Review of off-site fabrication, delivery schedules
- 2.2.1.5. Document clarification requests
- 2.2.1.6. Coordination items with other Contractors
- 2.2.1.7. Changes in the work affecting cost and/or time
- 2.2.1.8. Submittals and shop drawings
- 2.2.1.9. Field observations, problems, conflicts
- 2.2.1.10. Quality control issues and non-conformance resolutions
- 2.2.1.11. Safety issues

2.3. OTHER MEETINGS

- 2.3.1. QUALITY ASSURANCE MEETINGS - CM may conduct quality assurance/quality control meetings as necessary during the progress of the Work. CM will set the agenda for the quality meeting. At a minimum, the Contractor shall be prepared to discuss the following:
 - 2.3.1.1. Testing and inspection procedures
 - 2.3.1.2. Tolerance requirements
 - 2.3.1.3. Quality samples
 - 2.3.1.4. Reporting of non-conformance items
 - 2.3.1.5. Corrective actions assigned
 - 2.3.1.6. Disposal of non-conforming items
 - 2.3.1.7. Job procedures
- 2.3.2. SAFETY MEETINGS - Refer to Section 00810 Safety and Loss Control Program for more information.
- 2.3.3. INSPECTIONS TOURS - Formal inspections/tours may be made of the Project progress by the Owner, Architect, local, state or federal officials, insurance representatives, or others as the occasion warrants and as scheduled by CM. If requested by CM, each Contractor shall be prepared to show and explain Work throughout the building to the inspecting parties, in addition to providing Work in compliance with these inspections.
- 2.3.4. CHANGE REQUEST MEETINGS - Upon issuance of a major Proposal Request (a.k.a. bulletin), CM may conduct a meeting as necessary with all significant Contractors to review its contents and determine cost, delivery and schedule impacts. At a minimum, the Contractor shall be prepared to discuss the following:
 - 2.3.4.1. Impact of out-of-sequence work
 - 2.3.4.2. Identification of pertinent long-lead material and system impact
 - 2.3.4.3. Alternative recommendations
 - 2.3.4.4. Evaluation of approximate cost magnitude
 - 2.3.4.5. Evaluation of impact on completion
 - 2.3.4.6. Alternate sequencing
 - 2.3.4.7. Due date for Contractor pricing and scheduling impact

END OF SECTION 01310

SECTION 01320 COMMUNICATIONS

1. SUMMARY

1.1. This Section describes the following requirements including:

- 1.1.1. Meetings / Communications
- 1.1.2. Contractor Correspondence
- 1.1.3. Contractor's Daily Report
- 1.1.4. Request for Information (RFI)

2. METHODS OF COMMUNICATION

2.1. MEETINGS (previous Section 01310 – Meetings)

- 2.1.1. The CM shall schedule, chair, and administer all periodic meetings throughout the progress of the work for the purpose of coordinating and expediting the Work. Such meetings shall be held at the job site office bringing together responsible representatives of active Contractors for the purpose of planning, assessing progress and discussing problems of mutual concern. Each Contractor, and its Subordinate Parties' representative attending the meetings shall be authorized to act on behalf of and make decisions/commitments for the entity each represents, the decisions made at the meetings and each Contractor who should be in attendance will be held responsible for information and directions given at the meeting.
- 2.1.2. The CM will prepare and distribute the minutes of all meetings, if CM determines minutes are required. If the attendees do not object in writing to any part of the meetings within ten (10) days of distribution of the minutes, the minutes shall be accepted as written.
- 2.1.3. The scope of meetings include, but are not limited to:
 - 2.1.3.1. Preconstruction Meeting
 - 2.1.3.2. Job Progress/Coordination Meetings
 - 2.1.3.3. Other Meetings
 - 2.1.3.3.1. Quality Assurance
 - 2.1.3.3.2. Safety
 - 2.1.3.3.3. Inspection Tours
 - 2.1.3.3.4. Change Request

2.2. CONTRACTOR CORRESPONDENCE

- 2.2.1. All field and/or construction correspondence and/or communications must be directed through CM. All correspondence should list the following as appropriate:
 - 2.2.1.1. Project Name: **Troy School District – 2013 Bond Program – Series 2, Bid Package 19 – Larson Office Renovation, IAE storage room and Interior Doors (various buildings)**
 - 2.2.1.2. CM Job#: 140077
 - 2.2.1.3. Architect Job#: 13157B.1, 13158A.1, 13167A.1, 13173A.1, 13175E, 13178A
 - 2.2.1.4. Contractor Contact Information
 - 2.2.1.5. Subject: clearly indicate subject matter of correspondence

2.3. CONTRACTOR'S DAILY REPORT

- 2.3.1. Each Contractor will prepare and distribute daily to CM a comprehensive daily report to include pre-task planning and maintain it during the entire project period. The daily report shall be submitted to CM's superintendent by the end of the day for that day's Work. Each Contractor is responsible for specifically alerting CM to items which could result in claims or delays.
- 2.3.2. Each Contractor may provide its own daily report if it covers the same issues as addressed in CM's Contractor Daily Report / Pre-Task Plan form. The CM suggested report form will be provided to the Contractor and is in Section 01600 - Forms.
- 2.4. REQUEST FOR INFORMATION (RFI)
 - 2.4.1. The Request for Information (RFI) is in Section 01600 Forms.
 - 2.4.2. In the event that a clarification is required due to a question raised by the Contractor pertaining to the Contract Documents, the Contractor shall submit a Request for Information (RFI) to the CM, which will be forwarded to the Architect. The RFI should be sufficiently detailed to accurately describe the problem and provide a possible solution.
 - 2.4.3. The Architect will return the RFI to CM as expeditiously as possible with its reply. In some instances, the Architect may issue its reply to the RFI on other documents, in which case, the RFI will simply reference these documents.
 - 2.4.4. The RFI will be returned to the Contractor by CM. The Contractor is responsible to give proper notice as set forth in the Contract Documents if a response will cause the Contractor to incur additional expense or expend additional time which could impact the schedule. If extra work or an additional cost may exist due to the clarification, CM may issue a PCO- Quotation Only or PCO-Notice to Proceed to the Contractor.

END OF SECTION 01320

SECTION 01330 SUBMITTALS

1 SUMMARY

1.1. This Section describes the following requirements including:

- 1.1.1. Scope
- 1.1.2. Submittal Register
- 1.1.3. Submittal Requirements
- 1.1.4. Submittal Process and Responsibilities
- 1.1.5. Re-submission Requirements

2 SCOPE

- 2.1 Where requirements of this Section vary from the requirements of the General Conditions, this Section's requirements shall take precedence.
- 2.2 CM will prepare and submit a submittal register/schedule including close-out documentation for Contractor's use in preparing submittals required for the Project. Contractors shall complete the submittal schedule/register showing the dates for submission, lead times required and their expected delivery dates to maintain and follow the construction schedule. Dates for submission noted by Contractor must assume re-submittals will be required. Submittals received on the date scheduled will be processed as specified. CM/Owner/Architect will not be held responsible for delays due to receiving submittals after the date indicated in the Contractor's submittal schedule.
- 2.3 Submittals shall be submitted based on each technical specification section. Submittals containing information about more than one specification section will be returned for re-submittal.
- 2.4 Contractor is responsible to provide all submittals required under the Contract Documents, whether or not listed in the submittal register.
- 2.5 Furnish approved copies of shop drawings, diagrams, templates, catalog cuts, technical data, etc. to others for the purposes of coordination of this Work.
- 2.6 Coordination: Each Contractor shall coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 2.6.1 The Contractor, by providing the submittal assures the product or system submitted is available and deliverable in accordance with the schedule requirements.
 - 2.6.2 Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
 - 2.6.3 Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - 2.6.4 CM reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - 2.6.5 Coordinate each submittal as required with all trades and with all public agencies involved.
 - 2.6.6 Secure all necessary approvals from public agencies and others; signify by stamp or other means that all required approvals have been obtained.
 - 2.6.7 Material Compliance Certificate:
 - 2.6.7.1 The following forms are available upon request from the CM:
 - 2.6.7.1.1 Material Compliance Certificate
 - 2.6.7.1.2 Approved Submittal List for Material Compliance Certificate Use

- 2.6.7.2 Contractors may choose to complete the *Material Compliance Certificate* form which will serve as the Contractor's official submittal document and must meet all general submittal requirements. Only approved submittals listed on the *Approved Submittal List for Material Compliance Certificate Use*, prepared by CM, will be reviewed in this format.
- 2.6.7.3 Items available to utilize the Material Compliance Certificate can include a submittal that establishes a level of quality by complying with the manufacturer and manufacturer's designated identifier as called for in the Contract Documents. The Contractor is committed to using this exact specified component. This Certificate is contractually binding.
- 2.6.7.4 This form can be used for multiple submittal items. The Architect/Engineer will review and approve the Material Compliance Certificate in the same manner as a standard submittal.
- 2.6.7.5 In the event additional information would be required after submission and/or approval of the Material Compliance Certificate, the Contractor must provide this information promptly through the standard revision process.

3. SUBMITTAL REQUIREMENTS

3.1. GENERAL

- 3.1.1. Each submittal shall show Contractor's review stamp, with handwritten signature, certifying review of the submittal, verification of field measurements and compliance with the Contract Documents.
- 3.1.2. Each submittal shall be accompanied with a Submittal Transmittal Form. The following information shall be furnished by the Contractor on the submittal transmittal form:
 - 3.1.2.1. Original Date of submission and Revision Date(s).
 - 3.1.2.2. Project name and Architect's and the CM's project number
 - 3.1.2.3. Names of:
 - 3.1.2.3.1. Contractor
 - 3.1.2.3.2. Second-Tier Contractor (if applicable)
 - 3.1.2.3.3. Supplier
 - 3.1.2.3.4. Manufacturer
 - 3.1.2.4. Identification of product or material
 - 3.1.2.5. Technical Section number, clearly identified. On multiple submittals, a separate transmittal should be completed for each specification section on items being submitted.
 - 3.1.2.6. Reference to construction drawings by drawing number
 - 3.1.2.7. The quantity of each Shop Drawing, Product Data or Sample submitted
 - 3.1.2.8. Notification of deviations from Contract Documents
 - 3.1.2.9. For Shop Drawings, show relationship to adjacent structure or materials
 - 3.1.2.10. For Shop Drawings, show field dimensions, clearly stated as such.
 - 3.1.2.11. Applicable standards such as ASTM or Federal Specifications.
 - 3.1.2.12. Other pertinent data
 - 3.1.2.13. Submittals not so transmitted will be returned un-reviewed. Re-submissions shall be so noted on the transmittal.

3.1.3. Unless noted otherwise on the submittal, all submissions will be considered to be "as specified."

3.2. REQUIRED QUANTITIES OF SUBMITTALS (ELECTRONIC REVIEW VERSION)

3.3.1. In general, all submittals, except color or physical samples, are to be posted electronically in PDF document form for CM and the Architect/Engineer to electronically review and approve. CM will use Submittal Exchange as a posting site for the facilitation of this review and approval process. The following number of originals and copies will be required for each type of submittal.

Submittal Type:	Required submit quantities:	
	Electronic ¹	Other
.1 Shop Drawings – Structural Steel and all MEP	1	
.2 Shop Drawings – all other	1	
.3 Product Data – Structural Steel and all MEP	1	
.4 Product Data – all other	1	
.5 Samples	1	4
.6 Certificates ²	1	
.7 Warranties / Guarantees ²	1	
.8 Test Reports ²	1	
.9 Close-Out Material: O & M Data ²	1	
NOTES : ¹ ALL electronic submittals shall be in PDF format ² Items #6-9 above are to be submitted together as part of the Close-Out Packet when requested by CM		

3.3.2. All submittals will be reviewed electronically via Submittal Exchange, and an electronic submittal transmittal is required. Reviewed versions will be posted back to Submittal Exchange. CM will notify Contractor of the posting and availability for Contractor to download the reviewed version. Paper copies will not be returned to the Contractor.

4. TYPES OF SUBMITTALS

4.1. SHOP DRAWINGS

- 4.1.1. Provide Shop Drawings as complete submittals (no partial sets) on original drawings or information prepared solely by the fabricator or supplier. In no instance shall the Contract Drawings be reproduced for Shop Drawing submittals.
- 4.1.2. Sheet sizes shall not exceed the size of the Contract Drawings or smaller than 8-1/2" X 11".
- 4.1.3. Each drawing shall have blank spaces large enough to accept three (3) 3" x 6" review stamps of the Contractor, the CM, and the Architect.

4.2. PRODUCT DATA

- 4.2.1. Modify Product Data sheets to delete information that is not applicable to the Project. Provide additional information if necessary to supplement standard information.
- 4.2.2. Product Data Sheets that are submitted with extraneous information not deleted and/or modified will be returned without review to the Contractor for re-submittal.

4.3. SAMPLES

- 4.3.1. Provide physical Samples to illustrate materials, equipment or workmanship, and to establish standards by which completed work may be judged as required by the technical section.
- 4.3.2. Provide Office Samples in sufficient size or as defined in the technical specifications and quantity to clearly illustrate full range of colors, textures, etc. available and the functional characteristics of the product or material.

- 4.3.3. Erect Field Samples or mock-ups as required by the technical sections and/or CM, at the Project site in a location designated by CM. Construct field samples complete, including Work of all trades required in finishing the Work. Provide Field Samples at the request of the Architect and/or CM where construction materials and/or methods deviate from the requirements of the intent of the Contract Documents or conventional construction practice.

4.4. CERTIFICATIONS

- 4.4.1. Certifications shall clearly identify the materials in reference and shall state that the material and the intended installation methods, where applicable, are in compliance with the Contract Documents for this project. Attach manufacturer's affidavits where applicable.

4.5. WARRANTIES/GUARANTEES

- 4.5.1. Provide warranties and/or guarantees as required by the various technical sections and other Contract Documents on the Contractor's letterhead in accordance with the requirements of the documents.
- 4.5.2. Refer to Section 01700 for additional close-out information and requirements including the standard CM Contractor's Guarantee Form that must be signed, without modification, in order to receive final payment. A copy of this form is either found in Section 01600 or is available upon request.

4.6. OPERATING AND MAINTENANCE MANUALS

- 4.6.1. Provide operating and maintenance manuals/data as required by the various technical sections in accordance with the requirements of the documents.

5. SUBMITTAL PROCESS AND RESPONSIBILITIES

5.1. Contractor's RESPONSIBILITIES

- 5.1.1. After the CM's and Architect's review, within one (1) week of receipt, Contractor is to distribute copies of the reviewed submittal to any supplier/fabricators, second or lower tier Contractors or other Contractors that must coordinate with this work. Contractor must maintain one copy at the Project Site for reference use.
- 5.1.2. Do not begin Work which requires submittals until return of submittals with CM's and Architect's stamp and initials indicating review with direction to proceed from either CM or Architect.
- 5.1.3. Contractor's responsibility for errors and omissions in submittals is not relieved by CM's or Architect's review of submittals.
- 5.1.4. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by CM's or Architect's review of submittals unless CM and Architect give written acceptance of specific deviations.

5.2. CM'S RESPONSIBILITIES

- 5.2.1. CM's review is for general administrative purposes only and neither this review, nor any subsequent approval by CM of a submittal, shall relieve Contractor from its obligations to comply fully with the Contract Documents.
- 5.2.2. CM will make changes or notations directly on the submittals, identify such review with its review stamp, sign and forward acceptable submittals to the Architect.
- 5.2.3. After the Architect's review, CM will forward submittals to the Contractor and retain one copy.

5.3. ARCHITECT'S RESPONSIBILITIES

- 5.3.1. Architect will review submittals within fourteen (14) Days after receipt, checking only for conformance with the design compliance of the Project and compliance with information given

in the Contract Documents. If the submission is large and/or requires detailed or lengthy review by the Architect, additional time may be required.

5.3.2. Architect will return to CM without review any submittals not bearing the Contractor's or CM's review stamp or not showing that it has been reviewed by the Contractor and CM.

5.3.3. Architect will make changes or notations directly on the submittal, identify such review with its review stamp, obtain and record Architect file copy and return the submittal to CM.

5.4. RE-SUBMISSION REQUIREMENTS

5.4.1. For Shop Drawings: Review returned CM and/or Architect drawings and re-submit as specified. All changes made must be identified through bubbling or other approved method.

5.4.2. For Product Data and Samples Resubmit new data and samples as required.

END OF SECTION 01330

SECTION 01360
COORDINATION (GENERAL)

1 COORDINATION OF WORK/COOPERATION

- 1.1 All Contractors are required to review, discuss and coordinate their Work with the Work of other contractors, Owner and CM with regard to sequence, timing, built-in Work and equipment, layout, location, compatibility of materials and sizes and required clearances prior to beginning the work to avoid construction delays which impact the Owner's occupancy of the facility.
- 1.2 Each Contractor
 - 1.2.1 Coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
 - 1.2.2 Make provisions to accommodate items scheduled for later installation.
 - 1.2.3 Provide to all other trades all information (drawings, diagrams, templates, embedments, etc.) necessary for the coordination of the Work.
 - 1.2.4 Layout and install its Work at such time and in such manner as not to delay or interfere with the carrying forward of the Work of others.
 - 1.2.5 Verification and Acceptance of previous work
 - 1.2.5.1 As Work under each Agreement commences, the condition of preceding Work under other agreements shall be verified and accepted by each subsequent Contractor when appropriate.
 - 1.2.5.2 Report in a prompt manner any interferences, discrepancies or incompatibilities discovered to CM, whose decision as to the Contractor at fault and as to the manner in which the matter may be resolved, shall be binding and conclusive on Contractors involved. CM may direct layout/ location changes as required to make the entire work fit together. Reasonable changes of this nature will not entitle any Contractor to an increase in contract price.
 - 1.2.5.3 Verification may, at CM's discretion, include a joint review by the subsequent Contractor, previous contractor(s), and CM to note any corrective Work required, similar items affecting the Work and particularly items which prevent acceptance by the subsequent contractors.
 - 1.2.5.4 The verification review procedures and findings shall be submitted in writing by subsequent Contractors to the CM.
 - 1.2.5.5 Any corrective work necessary to satisfy requirements of the Contract Documents shall be performed promptly by the previous Contractor to prevent delay to the work under the subsequent Contracts.
 - 1.2.5.6 After corrective work is accomplished the subsequent Contractor shall furnish written acceptance of the work as noted above.
 - 1.2.5.7 CM's participation in a joint review under this paragraph shall in no event be deemed to constitute approval of any layout or other Work that fails to comply with the **Contract Documents**.
 - 1.2.6 Observation of the Work by others shall not relieve Contractor from its responsibility for coordination, supervision, or scheduling and direction of the Work.
 - 1.2.7 Failure of a Contractor to notify others and CM of a potential interference, incompatibility, or discrepancy and any failure to coordinate Work with that of others prior to installation and/or fabrication shall be at the Contractor's risk.

END OF SECTION 01360

SECTION 01370 COORDINATION DRAWINGS

1. GENERAL REQUIREMENTS

- 1.1. Contractor if required by its Work scope, shall be responsible for developing coordination drawings and participating in coordination meetings as defined herein, and shall have included the cost for such Work in its Bid Proposal.
- 1.2. Coordination Drawings shall be utilized to establish installation sequence, resolve trade coordination issues prior to installation and to make the most efficient use of space allocated for systems such as mechanical/electrical/plumbing installations without sacrifice to systems performance. This is also required to determine inter-relationships and possible interference's between all of the trades' Work and the architectural or structural features.
- 1.3. Contractors are required to attend coordination meetings as required by CM. The representative(s) from each Contractor is required to be familiar with the Work and have the expertise and authority to answer questions and make decisions and changes to its systems at these meetings.
- 1.4. The coordination drawings may also be used by Contractor as part of its required shop drawing and as-built drawing submittals.
- 1.5. Each Bidder should anticipate that each floor may require several meetings. However, in the interest of time, multiple floors or areas may be reviewed in one meeting. Development of coordination drawings will be by area and floor with order of priority established by CM.

2. COORDINATION DRAWING PROCESS

- 2.1. The Electrical Contractor, following an HVAC coordination kick-off meeting, shall immediately begin Work and prepare 1/4" scale layout drawings of all ductwork and piping. These drawings shall also show registers, grilles, diffusers, and similar features. Contractor shall include locations of all valves, dampers and shall note any items requiring access for service and maintenance as well as access doors in inaccessible ceilings. Drawings shall also show the size, layout and routing of all metal and flex ductwork, re-heat coils, terminal units, filters, and major hangers and supports. Contractor shall provide notation for diffuser boot sizes and heights and any other special features. Contractor shall provide cross sections and additional details through areas where clearances are tight and further detail as appropriate and/or required. Where piping or ductwork has external insulation, Contractor shall note or show locations and thickness. Contractor shall indicate bottom elevation of duct, pipes and equipment and elevation changes, to be measured to the lowest point including insulation and hangers where applicable.
- 2.2. In areas where no HVAC work occurs, but where other mechanical and electrical installations are installed, the Electrical Contractor will issue or note on transparencies indicating "No HVAC Work Required".
- 2.3. Within fifteen (15) working days of issuance, the Electrical Contractor shall have completed layout drawings and provide to CM. At this time, all Contractors shall attend a Coordination Kick-Off Meeting at which time the first distribution of HVAC prints is made and procedures and schedule are reviewed.
- 2.4. As layout drawings for HVAC Work for subsequent areas are completed, the Electrical Contractor shall provide prints of the completed layout drawings to CM. CM will in turn distribute prints to each required Contractor to include Plumbing, Fire Protection and Electrical Work. Respective Contractors shall then layout their own routings. Drawings shall include other major items such as valves, access panels, switch panels, pull boxes also noting items requiring access for service and maintenance, etc. as well as access doors in inaccessible ceilings.
- 2.5. Information for specific trades is required but not limited to the following:
 - 2.5.1. Plumbing - Size, layout and routing of piping, valves, boxes, supports, etc., for all utilities regardless of material size. Show or note all pipe sizes and working clearances around valves, etc. For pitched piping, identify bottom elevations at key points and at least every column line. Note thickness and location of all external insulation. Bottom elevations shall be measured to the lowest point including hangers and insulation where applicable.

- 2.5.2. Sprinkler Piping - Size, layout and routing of mains and branch piping, hanger and supports, valves, working clearances, and bottom of pipe and bottom of hanger support elevations. Sprinkler head locations shall be shown on ceiling plans. For pitched piping, identify bottom elevation at key points and at least at every column line.
- 2.5.3. Electrical - Size, layout and routing and size of conduit and wire 2" or larger for normal and emergency power distribution systems, 1-1/2" or larger for communication systems telephone, nurse call, physiological monitoring, etc., include all systems specified, boxes larger than 4" x 4" x 4", hangers, supports, and electrical fixtures including lights, speakers, detectors, sensors, cable trays, raceways, etc. Size and clearance of ceiling and above ceiling mounted items shall be noted as a depth from finished ceiling to top of fixture or top of clear area required. Provide bottom elevations of conduits and equipment. Bottom elevation shall be measured from the lowest point, including hangers.
 - 2.5.3.1. Within four (4) feet of all panels, or areas where more than 4 conduits, regardless of size, are routed or grouped together, identify an easement or right-of-way for the groups of conduit.
 - 2.5.3.2. Also show all wall mounted items located within 12" of the ceiling plane.

3. EXECUTION

- 3.1. In the preparation of all coordination drawings, 1/2" scale details as well as cross and longitudinal sections are required to fully delineate all conditions. Particular attention shall be given to the locations, size and clearance dimensions of equipment items, shafts, corridors and similar features.
- 3.2. After completion of the final coordination drawings, minor changes in duct, pipe or conduit routings that do not affect the intended function may be made as required to avoid space conflicts, when mutually agreed to by all parties involved. However, items may not be re-sized or exposed items relocated without CM's written approval. No changes shall be made by Contractors in any wall or chase locations, ceiling heights, door swings or locations, windows or other openings, or other features affecting the function or aesthetic effect of the building. If conflicts or interference's cannot be satisfactorily resolved, Contractors shall notify CM who will, in turn, obtain a decision from the Architect.
- 3.3. Other Contractors responsible for supplementary composite drawings, as indicated herein, shall make similar distribution to that described in item 1.03 Paragraph E. All trades desiring additional prints of such drawings, beyond the basic distribution indicated above, shall arrange for and pay the cost of same.
- 3.4. Record copies of final drawings shall be retained by CM and each Contractor as working reference. All shop drawings, prior to their submittal to CM shall be compared with the final drawings and developed accordingly by the Contractor responsible. Any revision to the drawings which may become necessary during the progress of the Work shall be noted to and by all Contractors and shall be neatly and accurately recorded on the record copies. Each Contractor shall be responsible for the up-to-date maintenance of its own record copies of the final drawings, and any subsequent changes thereto shall be utilized by CM and each Contractor in the development of As-Built/Record drawings described in Section 01720 of the Project Manual.
- 3.5. The HVAC drawings need not be submitted as a whole, but they shall be submitted in all cases per CM's project master construction schedule and in ample time to avoid construction delays. The coordination drawings of all trades may lack complete data in certain instances pending receipt of shop drawings, but sufficient space shall be allotted for the affected items. When final information is received, such data shall be promptly inserted on the final drawings.
- 3.6. No extra compensation will be paid for relocating any duct, pipe, conduit, or other material that has been installed without proper coordination between all Contractors involved. If any improperly coordinated Work, or Work installed that is not in accordance with the approved coordination composites, necessitates additional Work by the other Contractors, the costs of all such additional Work shall be solely borne by the Contractor responsible.
- 3.7. All changes in the Scope of Work due to revisions formally issued and approved shall be shown on that trade's final drawings and thoroughly coordinated with the other trades.

- 3.8. All Work on the coordination composite drawings shall be performed by competent draftsmen and shall be clear and fully legible. CM shall be sole judge of the acceptability of the drawings. All drawings shall be drawn dimensionally and graphically correct.
- 3.9. In general and before the first meeting the following guidelines shall be followed:
 - 3.9.1. All trades shall coordinate with the Electrical Contractor for the size, height and clearance requirements for recessed or semi recessed light fixtures, recessed speakers/detectors, and other electrical ceiling devices.
 - 3.9.2. Sprinkler heads shall be centered in the center of lay-in ceiling tiles unless approved shop drawings note otherwise.
 - 3.9.3. All elevations shall be based on height above finished floor using established benchmarks.
 - 3.9.4. Standard suspended ceiling systems require 3" minimum clearance for materials and installation.
 - 3.9.5. Review of other drawings may be necessary for special structural and suspended equipment requirements.
 - 3.9.6. All trades to hang work as high as possible in above ceiling areas, allowing access to equipment for maintenance, repairs, connections, filters and removal without demolition of other Work.
- 3.10. Coordination drawings submitted during this process are not considered shop drawing submittals. The coordination drawings may be part of the required shop drawing submittal, but are made separate from the distribution specified in this section.

END OF SECTION 01370

SECTION 01400 QUALITY REQUIREMENTS

1. DOCUMENT CONTROL PROCEDURE

- 1.1. Each Contractor is to provide CM its document control procedure to include drawing submittals and surveillance. In the absence of such a procedure, the Contractor will use the following procedure for document control.

“A log is maintained identifying the drawing revision status, issue date and distribution (internal and external). The transmittal issuing the changed documents will indicate what changes are made and indicate that the documents are approved for use. Contractor meetings include a review of approved drawings. The review is documented in the meeting minutes. Superintendent surveillance activities include monitoring Contractor drawing use.”

2. QUALITY CONTROL

- 2.1. Each Contractor is responsible to provide the Owner with a completed quality product for its Work. Each Contractor shall be responsible for any costs associated with re-testing and re-performing the Work as a result of the Contractor's poor performance or workmanship or other failure to comply with the Contract Documents.
- 2.2. All Work shall be done by persons qualified in their respective trades, and the workmanship shall be first-class in every respect. **Each Contractor is responsible for ensuring employees are appropriately trained.** All materials and equipment furnished shall be the best of their respective kinds for the intended use and unless otherwise specified, same shall be new and of the latest design.
- 2.3. The Contractor shall provide CM, Owner and Architect access to the Work in preparation and progress wherever the Work is located at all reasonable times.

Note: CM and the Architect will have the authority to reject Work that does not conform to the Contract Documents or may require special inspection or testing, whether or not such Work is to be then fabricated, installed or completed. The Architect shall make all decisions with respect to questions concerning the quality or fitness of materials, equipment and workmanship.

- 2.4. Failure by a Contractor to conduct its operations, means and methods and coordinate proper sequencing of the Work may cause the Troy School District to withhold payment or any other means deemed necessary to correct non-conforming Work.

3. NOTIFICATIONS AND CORRECTIONS OF NON-CONFORMANCE

- 3.1. CM and the Architect may conduct observations/evaluations of the Contractor's Work. CM and/or Architect's reviews do not relieve the Contractor from compliance with the Contract Documents or necessary corrections for deficiencies thereof. Contractors whose Work does not meet the standards set by the Contract Documents will be notified by representatives of the CM using a Corrective Action Report. The Contractor, upon receipt of the Corrective Action Report, shall complete and return the form and provide the corrective actions necessary in a timely manner as outlined.
- 3.2. The **Corrective Action Report (CAR) (CON 18.2)** is in Section 01600 Forms.

4. CONTRACTOR PERFORMANCE EVALUATION

- 4.1. CM will be evaluating Contractor's performance and will provide feedback during the life of the Project, on Contractor's performance, for the purpose of improving CM's Contractor selection process for future project endeavors.
- 4.2. This Contractor Performance Evaluation form is generated by the CPS Database.

END OF SECTION 01400

SECTION 01450
TESTING AND INSPECTION SERVICES

1. CONTRACTOR'S RESPONSIBILITIES

- 1.1. The testing firm will report directly to the Troy School District. Copies of test and inspection reports will be furnished to the appropriate Contractors. The laboratory and its representatives will be instructed to promptly call to the attention of the Contractor any instance of non-compliance with the requirements of the Contract Documents. Failure to so notify the Contractor shall not relieve the Contractor of any of its responsibilities for compliance or making good workmanship or materials which are not in compliance with the requirements of the Contract Documents.
- 1.2. Each Contractor shall cooperate with the testing firm and provide labor to assist and lifts, ladders or other means to permit full access for testing firm and to assist with sample preparations where applicable.
- 1.3. The Contractor is responsible to pay the cost of additional testing in the event that additional testing of the Contractor's materials, installation, and other Work is required by the independent testing laboratory because of test results not in compliance with the Contract Documents and/or additional testing required as a result of Contractor's negligence or poor workmanship.

2. CONTRACTOR RESPONSIBILITIES

2.1. CONTRACTOR SHALL:

- 2.1.1. Notify CM sufficiently in advance of operations (24-hours minimum) to allow for laboratory assignment of personnel and scheduling of tests.
 - 2.1.1.1. When tests or inspections cannot be performed after such notice, reimburse Troy School District for all expenses incurred arising out of or resulting from Contractor's negligence.
- 2.1.2. When the Contractor is providing the testing and prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered engineer and responsible officer. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards (NBS) during most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.

3. RE-TEST RESPONSIBILITY

- 3.1. Where the results of required inspections, tests, or similar services prove unsatisfactory and do not indicate compliance with the requirements of the Contract Documents, the re-tests shall be the responsibility of the Contractor regardless of whether the original test was the Contractor's responsibility.
- 3.2. Re-testing of Work revised or replaced by the Contractor is the Contractor's responsibility where required tests were performed on original Work. All costs and fees for re-testing shall be paid by the Contractor.
- 3.3. Schedule delays and costs which are the result of non-conforming work or remedy will be the responsibility of the offending Contractor.

END OF SECTION 01450

SECTION 01500 INTERIM LIFE SAFETY PLAN

1. PURPOSE AND POLICY

- 1.1. **PURPOSE:** To provide interim life safety measures during a construction Project. To protect Owner personnel, visitors, [patients] and property from fire and injury during remodeling or construction. This policy is used wholly or in conjunction with the safety program in the Project Manual.
- 1.2. **POLICY:** During a construction Project it shall be the responsibility of the Director of Facilities (or designee) and CM (through trade Contractors) to maintain compliance with the Life Safety Code NFPA Section 101. Compliance will be through the implementation of the following:

2. NOTIFICATIONS

- 2.1. Contractor shall communicate with and coordinate through CM for all changes to Life Safety measures including changes to: egress, the fire suppression system, the fire alarm system or any other Life Safety related changes to the construction site. Contractor is required to simultaneously notify the appropriate Owner personnel / departments: Owner's PM, Security, Facilities, Safety, Local and/or state fire, 911 emergency services, etc.
- 2.2. Advanced notification using the appropriate form shall be submitted not less than twenty-four (24) hours in advance of the work. Forms can be obtained through CM.

SHUTDOWN REQUEST TYPE	FORM NAME [VERIFY WITH OWNER'S REQUIREMENTS]	SUBMIT FORM IN ADVANCE OF PROPOSED WORK BY:	SUBMIT FORM TO:
CHANGE IN EGRESS:	Submit egress plan of existing exiting and proposed change	3 Weeks	CM; CM to schedule a review meeting with the Owner and Architect for final approval
Change in Fire Suppression	Sprinkler Shut-Down Request	1 Week	CM for initial review 5 days prior; upon approval from CM simultaneously submit to CM, Safety, Security, OTHERS
Change in Fire Alarm	Fire Alarm Shut-Down Request	1 Week	CM for initial review 5 days prior; upon approval from CM simultaneously submit to CM, Safety, Security, Owner's Insurance Agency, State and/or Local Fire Department, ,VERIFY OTHERS
Mechanical Piping, HVAC or Electrical Shut-Down	Utility Shut-Down Request	1 Week	CM for initial review 5 days prior; upon approval from CM simultaneously submit to CM, Safety, Facilities, Security, OTHERS

3. INTERRUPTION OF EXIT - EGRESS CORRIDOR

- 3.1. Should construction of temporary structures for egress/exit be necessary:

- 3.1.1. Contractor will review with and obtain approval from CM any changes to the means of egress. This review and approval shall include the Owner and Architect to confirm appropriate travel distances to exits are maintained/established.
- 3.1.2. Contractor shall obtain approval from the appropriate agency for any planned temporary exiting structure prior to construction/implementation.
- 3.1.3. All Contractors shall be responsible for maintaining temporary egress/exits:
 - 3.1.3.1. Each Contractor is responsible to protect, kept free of restrictions or obstructions, and maintain in full use all entrances to and exits from existing buildings and the construction site at all times. The safety and well-being of all persons must be of prime concern.
 - 3.1.3.2. Contractor shall maintain and not disturb any temporary construction, including stairs, ramps, protected walkways, railings, lights and direction signage as required to maintain adequate exiting from the existing building.
- 3.2. Should an alternate egress route be necessary:
 - 3.2.1. Contractor shall submit the appropriate forms to CM so all affected departments will be notified. Contractor shall not begin any work associated with a change in egress until the Owner has verified its internal departments are notified and prepared for the change.
 - 3.2.2. Contractor shall install and maintain temporary exit signage and Contractor shall install and maintain temporary directional signage prior to starting Work associated with the change in egress..
- 4. INTERRUPTION OF THE SPRINKLER SYSTEM
 - 4.1. Refer to the above matrix for advanced notification times and shut-down request distribution.
 - 4.2. Priority will be given to localized interruption of these systems on first shift Monday through Friday when full staff is available when any shut down is necessary:
 - 4.3. Contractor will provide an organized fire watch until the system is fully functional.
- 5. INTERRUPTION OF FIRE/SMOKE DETECTION AND ALARM SYSTEM
 - 5.1. Refer to the above matrix for advanced notification times and shut-down request distribution.
 - 5.2. Contractor shall maintain the operation of the total fire detection/alarm during the construction.
 - 5.2.1. It is acceptable for the Contractor to place a thin plastic cover over the detector head during high dust producing activities with Contractor's prompt removal upon completion of the work.
 - 5.2.2. At all other times the system will be returned to normal operating status.
 - 5.3. Should the fire/smoke detectors and alarms systems be interrupted:
 - 5.3.1. Contractor will provide an organized fire watch until the system is fully functional.
 - 5.3.2. Temporary alarm pull stations will be established as a minimum should the interruption last more than twenty-four (24) hours.
- 6. CONSTRUCTION SITE MAINTENANCE
 - 6.1. For interior construction. Contractor **shall:**
 - 6.1.1. Refer to the above matrix for prior notifications.
 - 6.1.2. Maintain existing Fire/Smoke Barriers and compartments.
 - 6.1.3. Provide and maintain temporary partitions adjacent to functioning departments that are a UL rated 2-hour assembly and smoke/dust tight and non-combustible. Provide documentation of the UL rated assembly type to CM prior to constructing this Work.

- 6.1.4. Maintain temporary enclosures, fire-rated dust curtains, and all other necessary materials and equipment as required to prevent introduction of dust, dirt or debris into occupied portions of the building.
- 6.1.5. Coordinate locking of the construction area with CM and the Owner.
- 6.2. For exterior construction - Contractor shall:
 - 6.2.1. Maintain site clearance for access to the external fire department connections.
- 7. REFERENCES
 - 7.1. All current Life Safety codes

END OF SECTION 01500

SECTION 01520 TEMPORARY CONSTRUCTION

1 SUMMARY

1.1 This Section describes the following requirements including:

- 1.1.1 Project Signage
- 1.1.2 Snow Removal
- 1.1.3 Security
- 1.1.4 Temporary Field Office, Facilities and Parking
- 1.1.5 Temporary Fencing
- 1.1.6 Temporary Toilet Facilities
- 1.1.7 Drinking Water/Temporary Water
- 1.1.8 Roof Protection
- 1.1.9 Scaffolding
- 1.1.10 Water Control
- 1.1.11 Temporary Material Hoist/Elevator
- 1.1.12 Fire Precautions and Protection
- 1.1.13 Noxious Odors and Fumes
- 1.1.14 Temporary Stairs, Ladders, Ramps, Runways, and Barricades
- 1.1.15 Temporary Electrical Power and Light
- 1.1.16 Temporary Heating and Weather Protection
- 1.1.17 Temporary Enclosures

2 CONSTRUCTION FACILITIES

2.1 PROJECT SIGNAGE

- 2.1.1 The CM shall provide a project sign. No other signs or advertising shall be displayed on the premises without the approval of the Architect, Owner, and CM. This does not exclude the posting of required trade notice and cautionary signage by Contractors.

2.2 SNOW REMOVAL

- 2.2.1 Contractors performing Work under exposed conditions shall remove snow and ice for the protection and execution of their Work. Keeping public traffic areas and circulation routes free of snow shall be the responsibility of the CM/DESIGNATED CONTRACTOR.

2.3 SECURITY

- 2.3.1 The services of a security guard(s) will not be provided by CM.
- 2.3.2 Each Contractor, at its own cost and expense, may provide security guard, protective service or other means of site security as it deems necessary.
- 2.3.3 Contractors shall advise CM of any theft or damage which might delay the execution of the Work and furnish the Owner and CM with a copy of any theft report filed with local, county or state agencies.
- 2.3.4 Neither CM nor Owner assumes any responsibility for loss, theft or damage to the Contractor's materials or for damage to Work in place before the completion of the construction. In the instance of any such loss, theft or damage, the Contractor shall be responsible to renew, restore or

remedy the Work, tools, equipment and construction in accordance with requirements of the Contract Documents without additional cost to CM.

2.3.5 CM is not responsible for damage, liability, theft, casualty or other hazard to the automobiles or other vehicles, nor to injury, including death, to occupants of automobiles or other vehicles on the Owner's property.

2.3.6 CM may establish additional security policies and procedures. All Contractors will be required to cooperate with CM in implementing these procedures.

2.3.7 Site-parked equipment, operable machinery and hazardous parts of the new construction subject to mischief and accidental operation shall be inaccessible, locked or otherwise made inoperable when left unattended.

2.4 TEMPORARY FIELD OFFICE, FACILITIES AND PARKING

2.4.1 The Owner may designate an area for construction trailers. Placement and scheduled duration shall be coordinated by CM. Each Contractor is responsible to verify that all field offices, trailers and storage sheds shall be in accordance with the local Fire Marshal having jurisdiction. Each Contractor shall arrange and pay for its own telephone hookup and use. Each Contractor shall arrange and pay for its own temporary electrical hook-up, water and toilets. The Contractor shall pay for all power used for the Contractor's temporary field office and temporary electrical service. Construction personnel will be allowed to use the existing Owner parking facilities. Designated Contractors will be allowed to have on-site construction trailers. Construction trailers shall be limited to 10' x 30' or smaller.

2.4.2 Contractors shall maintain the use of designated space for offices and sheds. This includes removal of weeds, debris, trash and clean-up of the area after removal of such temporary structures.

2.4.3 Temporary field offices and sheds shall not be used for living quarters. .

2.4.4 Offices and sheds shall be of suitable design, maintenance and appearance, and meet the approval of CM and all applicable local codes and ordinances.

2.4.5 All temporary offices and sheds including foundations, must be removed within ten (10) days of written notice from CM including restoration of grade. Structures not removed in a timely manner will be removed by CM at Contractor's expense.

2.4.6 If a temporary office is built in the building, it must be fire treated in accordance with Section 01510, Fire Precautions and Protection.

2.5 TEMPORARY FENCING

2.5.1 The DESIGNATED CONTRACTOR shall provide temporary fencing with gates for required access and remove same at the completion of the Project.

2.5.2 The Contractors shall repair or replace fencing damaged as a result of its operation. Contractors shall remove and replace fencing and gates required to provide access for oversized items.

2.5.3 Contractor's personnel are not allowed to work outside of the construction fence without permission of CM.

2.6 TEMPORARY TOILET FACILITIES

2.6.1 The CM shall provide and maintain temporary toilet facilities for the construction of the Project. The use of the Owner's existing permanent facilities is as described in Section 01140 Use of Premises.

2.6.2 During renovation activities, CM may obtain, through the Owner, permission to use designated toilet facilities within the contract boundaries for construction use. The use of the Owner's existing permanent facilities outside the construction boundaries is strictly not allowed.

2.7 DRINKING WATER/TEMPORARY WATER

- 2.7.1 The Owner will pay for water used on this. Each Contractor shall be responsible to provide containers, paper cups, ice, hoses, etc. for its needs.
- 2.7.2 Immediately after award of the Agreement, the Mechanical Contractor shall furnish, install, maintain and subsequently remove a temporary hookup to the Owner's potable water system where directed by CM for construction purposes. The Contractor shall provide all temporary piping and approved backflow prevention as necessary for distribution from the source. Distribution of temporary water will be paid for by Contractors requiring same. A minimum of two (2) hose bibs shall be provided by the Mechanical Contractor as directed by CM.

2.8 ROOF PROTECTION

- 2.8.1 Contractors and their Subordinate Parties, shall be responsible for damages to roofing, sheet metal and roof structure while performing Work. The Roofing Contractor will perform the repair Work at the expense of the Contractor responsible for the damage.
- 2.8.2 All Contractors will protect adjacent existing roof surfaces while performing their Work. No construction materials will be allowed to be placed on existing roof surfaces without prior approval of the Owner through CM.

2.9 SCAFFOLDING

- 2.9.1 Each Contractor is responsible for providing and maintaining any and all ladders, scaffolds, and other staging as required to complete all work. All such ladders, scaffolds and staging equipment shall be erected, maintained and subsequently removed by each Contractor in accordance with all applicable safety laws, rules and regulations.

2.10 WATER CONTROL

- 2.10.1 All pumping, bailing or well point equipment necessary to keep excavations and trenches free from the accumulation of water during the entire excavating and backfilling progress of the Work shall be the responsibility of the Contractor performing said excavations and trenches due to its scope of Work.
- 2.10.2 Each Contractor shall be responsible for keeping the building at grade and below free from water from the time the building backfill is completed until the building is watertight.
- 2.10.3 Dispose of water in such a manner as will not endanger public health or cause damage or expense to public or private property. Abide by the requirements of any public agencies having jurisdiction.

2.11 TEMPORARY MATERIAL HOIST/ELEVATOR

Each Contractor is responsible for its own hoisting and material/ equipment movement costs as required to complete the Work under its Agreement.

- 2.11.1 CM may operate and maintain a permanent elevator until such time as all material hoisting requirements have been met. Elevator requirements in excess of the capacity or size of this elevator shall be provided by each Contractor at its expense. This elevator shall not be used for the placement of concrete, the transporting of workers, or other means inconsistent with its use as directed by CM. The operating cost for all overtime use of the elevator shall be paid by the Contractor requiring such services.
- 2.11.2 The Elevator Contractor shall be obligated to extend warranty and guarantee periods on any permanent equipment used prior to Substantial Completion.
- 2.11.3 Transportation of construction materials through the Owner's facility shall be accomplished in accordance with the requirements described in Section 01140 Use of Premises in such a manner so as to:
 - 2.11.3.1 Not damage any of the existing facility.
 - 2.11.3.2 Not impair the Owner's use of the facility.

2.11.3.3 Not create any type of mess or additional cleaning requirements in Owner occupied areas.

2.11.4 The Owner's lifting equipment is not available for the unloading, conveying or installation of Contractor's materials.

3 FIRE PRECAUTIONS AND PROTECTION

3.1 All Contractors and their Subordinate Parties shall

3.1.1 Assume full responsibility and take all necessary precautions to guard against and eliminate all possible fire hazards and to prevent damage to any construction work, building materials, equipment, temporary field offices, storage sheds, and all other property, both public and private.

3.1.2 Conspicuously post the location of the nearest fire alarm pull box and the telephone number of the local fire department within the field offices and on the construction site adjacent to its Work

3.1.3 Take precautions to prevent fire hazards in accordance with all fire protection and prevention laws and codes. No open fires shall be permitted.

3.1.4 Shall not be permitted to perform welding, flame cutting, or other operations involving the use of flame, arcs, or sparking devices without submitting a Hot Work Permit to CM a minimum of 24 hours prior or without adequate protection and shielding. Hot Work Permits can be obtained through CM. All combustible and flammable material shall be removed from the immediate area of the hot work. Material shall be protected with a fire resistant tarpaulin to prevent sparks, flames, or hot metal from reaching materials.

3.1.4.1 Only fire resistant tarpaulins shall be used on this Project.

3.1.5 Provide the necessary personnel and firefighting equipment to effectively control incipient fires resulting from the hot work.

3.1.6 Provide its own fire extinguishers in the immediate area of the Work.

3.1.7 Review the entire Project at least once a week to make certain it has adhered to the conditions and requirements set forth herein.

3.1.8 Shall not bring into building at any one time more than a one day supply of flammable liquids such as oil, gasoline, paint or paint solvent

3.1.8.1 All flammable liquids having a flash point of 110 degrees F or below, which must be brought into any building, shall be confined to Underwriter's Laboratories' labeled safety cans.

3.1.8.2 The bulk supply of all flammable liquids shall be detached at least 75 feet from the building and from yard storage of building materials.

3.1.8.3 Spigots on drums containing flammable liquids are prohibited on the project site. Drums are to be equipped with approved vent pumps.

3.1.9 Not store or leave overnight within the confines of the permanent building any combustible materials.

3.1.9.1 This includes all internal combustion engines using gas or fuel oil.

3.1.9.2 Hoisting of flammable or combustible materials to the roof shall only be in quantities as needed for immediate use

3.1.10 Agree that, in the event of fire, all its workers anywhere on site will assist in extinguishing the fire

3.1.11 Coordinate with the Owner and CM the permanent fire protection water supply, fire extinguishing equipment, shut down and tie-ins between new and existing fire protection systems shall be installed at the earliest possible date.

- 3.1.11.1 As each sprinkler system is completed and placed in service, the control valve shall be sealed. Permission to break seals and close sprinkler valves shall be given only by CM with approval of the Owner.
 - 3.1.12 Not place shanties of combustible construction inside of any structure.
 - 3.1.12.1 Such shanties shall be detached at least seventy-five (75) feet from the building or as directed by CM with approval of the Owner.
 - 3.1.12.2 Totally incombustible shanties may be, if approved in writing by CM, located inside of the structure
 - 3.1.12.3 Use of only Underwriter's Laboratory approved heaters and/or stoves is permitted in field offices or storage sheds and they shall have fire resistive material underneath and at the sides near partitions and walls. Pipe sleeves and covering shall be used where stove pipe runs through walls or roof
- 3.2 FIRE EXTINGUISHERS
 - 3.2.1 Fire extinguishers shall be "all purpose", and not a water type, to meet the approval of the Fire Underwriter's Laboratory, and will be inspected at regular intervals and recharged if necessary.
 - 3.2.2 In areas of flammable liquids, asphalt or electrical hazards, extinguishers of the 15 lb. carbon dioxide type or 20 lb. dry chemical type shall be provided
 - 3.2.3 **CM** will provide and maintain in working order at all times during construction not less than a fire extinguisher for each 3000 sq. feet with travel distance not to exceed 100 feet.
 - 3.2.4 All other required extinguishers shall be provided by the Contractor creating such hazard
- 3.3 NOXIOUS ODORS AND FUMES
 - 3.3.1 Combustion engine equipment, tar kettles and any other items causing noxious odors or fumes, including diesel powered equipment, will NOT be allowed in the building or near air intake louvers or building entrances and exits. If intake louver locations are in doubt, consult with CM.
- 4 TEMPORARY STAIRS, LADDERS, RAMPS, RUNWAYS, AND BARRICADES
 - 4.1 Each Contractor is to provide and maintain all necessary temporary stairs, ladders, ramps, and runways to facilitate conveyance of workers, materials, tools, and equipment for proper execution of its Work. All protection and safety barricades, devices, covers, and all other necessary items shall be provided by each Contractor as it relates to the safe conduct of its Work and protection of people and property in its Work area in accordance with applicable law.
 - 4.2 Any Contractor or Subordinate Party performing excavation Work shall be responsible to furnish, install and maintain temporary barricades and/or fencing of all open excavations until such time as the backfilling is complete. Flasher lights shall be provided on barricades and fencing by the Contractor as requested by CM and in accordance with applicable law. As a minimum, all barricades across roads and walks shall have lights on them in working condition.
 - 4.3 Prior to the removal of all shoring and forms, the DESIGNATED CONTRACTOR shall be responsible for temporary protection at the building floor perimeters and openings. Immediately after the removal of all shoring and forms, the DESIGNATED CONTRACTOR shall furnish, install, and maintain all necessary temporary protections at the building floor perimeters and openings. Protection shall be OSHA 29 CFR Part 1926.502 (B) "Guardrail Systems" and shall include but not be limited to two line rails and toe boards. Each Contractor that disturbs any temporary protection for its Work is responsible to reinstall to its original condition the guardrail or barricade system for the protection of the workers and others until final construction of perimeter exterior wall and/or shaft openings is completed. All other protection and safety barricades, devices, covers, etc., including those at all roof areas, shall be provided by the DESIGNATED CONTRACTOR] Contractor as it relates to the safe conduct of its Work in accordance with all local, state and federal law, rules and regulations and the requirements of the Contract Documents and shall be in accordance with the most stringent requirements.

- 4.4 The DESIGNATED CONTRACTOR shall provide temporary guardrails at the building floor perimeters, interior shafts, all roof areas, or other openings, immediately after the erection of the steel or precast frame and with the installation of metal or decking. Protection shall be OSHA 29 CFR Part 1926.502 (B) "Guardrail Systems" and shall include but not be limited to two line rails and toe boards. This temporary protector shall be left in place after completion of the steel or precast frame for the use of all other Contractors. The DESIGNATED CONTRACTOR shall maintain and remove said guardrails and patch concrete. Each Contractor that disturbs any temporary protection for its Work is responsible to protect the area during its Work and to reinstall to its original condition the guardrail or barricade system for the protection of the workers and others until final construction of perimeter exterior wall and/or shaft openings is completed. All other protection and safety barricades, devices, covers, etc. shall be provided by this Contractor as it relates to the safe conduct of its Work in accordance with all local, state and federal regulations and the requirements of the Contract Documents, and shall be in accordance with the most stringent requirements.
- 4.4. Each Contractor and its Subordinate Parties shall provide and maintain in good repair barricades, overhead protection, guard rails, etc., as required by law or necessary for the protection of the public and personnel engaged in the Work from hazards incidental to performance of the Work. Contractor shall do everything necessary to protect the Owner's employees, the public and workers from injuries and to protect vehicles and other property from damage.

5. TEMPORARY ELECTRICAL POWER AND LIGHT

5.1. Electrical Energy Costs

- 5.1.1. The Owner will pay for electrical energy to operate temporary electrical power and lighting for the duration of the project at designated locations. Temporary power will be provided free of charge.

5.2. Power Source

- 5.2.1. The Electrical Contractor shall provide, install, and pay for labor, equipment and materials required to make connections to the Owner's power source and to provide temporary electrical power and light distribution. The Electrical Contractor shall coordinate the location of the electrical power and lighting as directed by CM.
- 5.2.2. The Electrical Contractor will provide for the CM's construction trailer a 120/208 volt (or 120/240 volt), 100 ampere single phase power source. The cost of hook up and removal of temporary electrical service to other contractor's trailer shall be each Contractor's responsibility.
- 5.2.3. Protection shall be provided for the power supply source complete with disconnect switch and other required electrical devices.

5.3. Rules and Regulations:

- 5.3.1. All temporary equipment and wiring for power, lighting and distribution requirements shall conform to OSHA/NFPA requirements and be in accordance with applicable provisions of governing laws, codes, and ordinances.
- 5.3.2. All temporary wiring and distribution equipment shall be maintained so as not to constitute a hazard to persons or property.

5.4. Temporary Power Distribution:

- 5.4.1. The Electrical Contractor will provide and maintain temporary power distribution as follows:
- Construction power shall be 120/208 volts, 3 phase, 4 wire plus ground. Provide the following outlets together with feeders, grounding, protective devices and ground fault interrupting devices.
- 5.4.1.1. Power centers - on each floor of the new building, provide a minimum of two (2) power centers or not less than one (1) per 10,000 s.f. rated not less than 100 amperes at 120/208 volt, 3 phase, 4 wire plus ground. Within the remodeled areas, provide at least one (1) additional similarly rated power center. Locate the power centers such that each will serve approximately equal areas and as far as possible, each be in the center of the respective area served.

- 5.4.1.2. 120 volt duplex outlets - Provide weatherproof, G.F.I. protected, 20 ampere grounded outlets at a minimum rate equal to 1 - duplex outlet per 400 square feet. Outlets may be grouped in clusters of up to six duplex types with corresponding pro-rated increase in area served, provided that every portion of the construction and remodeled premises can be reached from the nearest outlet using a flexible cord no more than 50 feet in length.
- 5.4.2. As partitions are erected, locations of power distribution points shall be added or relocated.
- 5.4.3. Ground Fault Circuit Interrupter (GFCI) protection will be provided on all temporary power receptacles and, where possible, directly on the circuit breaker supplying temporary power as referenced in NEC 305-6(a).
- 5.4.4. The assured equipment grounding conductor program is only to be used on circuits greater than 20 amps as referenced in NEC 305-6(b).
- 5.5. Temporary Electrical Light Distribution:
 - 5.5.1. The Electrical Contractor shall provide and maintain temporary electrical light distribution as follows:
 - 5.5.1.1. Lighting shall be achieved using 120 volt guarded incandescent fixtures, or other suitable fixture types, to Federal or State OSHA required minimum levels of illumination.
 - 5.5.1.2. 120 volt temporary lighting as required in interior work areas. In addition to these minimum requirements provide adequate security lighting at guarded entrances outside storage areas, parking areas, and in areas of Contractor's and Architect's field offices and sheds.
 - 5.5.2. As partitions are erected or other interferences which hamper achieving the minimum levels of illumination, locations of lighting distribution points shall be added or relocated.
 - 5.5.3. Task lighting in addition to OSHA required lighting shall be provided by each Contractor.
- 5.6. Temporary Power and Light for Special Conditions:
 - 5.6.1. Special conditions for temporary electrical power and lighting required by others shall be provided as follows:
 - 5.6.1.1. Each Contractor requiring service of capacity or characteristics other than specified must make arrangements with the Electrical Contractor and pay for their own installation, removal, and service.
 - 5.6.1.2. Where 3 phase power is required, the Contractor must pick up service at the distribution panel located outside the building addition.
 - 5.6.1.3. The necessary grounded portable cords, lamps, light-stands, and fuses from the distribution outlets to points of use shall be provided by each Contractor to suit its own requirements.
 - 5.6.1.4. Temporary power cannot be used for welding operations.
- 5.7. Servicing of Temporary Power and Lighting:
 - 5.7.1. The Electrical Contractor shall be responsible for the following:
 - 5.7.1.1. Servicing, repairing and rearrangement of service equipment, temporary power, temporary lighting, and re-lamping.
 - 5.7.1.2. Removal and disposal of temporary electrical power and lighting at completion of the Project or when so directed by CM and repair of damage caused by installation or removal.
- 5.8. Permanent Electrical Power and Lighting:

- 5.8.1. When permanent electrical power and lighting systems are in operating condition, they may be used for temporary power and lighting for construction purposes provided the Electrical Contractor:
 - 5.8.1.1. Obtains the approval of the Architect and/or Owner through CM.
 - 5.8.1.2. Assumes full responsibility for operation of the entire power and lighting systems.
 - 5.8.1.3. Verifies that warranty dates are established prior to usage of equipment and lamps.
 - 5.8.1.4. Pays costs for operation, maintenance, and restoration of the systems.
- 5.8.2. As permanent power and lighting becomes available, these systems will generally supplant the appropriate portions of the temporary installation.

6. TEMPORARY HEATING AND WEATHER PROTECTION

- 6.1. Temporary heating requirements during the course of construction shall be divided into two categories as follows:
 - 6.1.1. Cold weather protection.
 - 6.1.2. Temporary heating.
- 6.2. Cold Weather Protection:
 - 6.2.1. Heating required during the construction period prior to enclosure of the building shall be classified as "cold weather protection."
 - 6.2.2. Each Contractor shall provide temporary heating and protection, necessary to allow its Work to continue during cold weather to meet the project milestone dates prior to building enclosure, including:
 - 6.2.2.1. The heating of materials (such as water and aggregate) as well as space heating for protection of newly placed or built construction at required temperatures (but not lower than 50 degrees F) and for the time specified.
 - 6.2.2.2. Fire retardant tarpaulins and other materials used for temporary enclosures.
 - 6.2.3. Each Contractor shall provide plan to allow Work to continue without regard to temperature.
 - 6.2.4. Heat shall be provided by smokeless UL approved portable unit heaters, using fuel of types and kinds approved by Underwriter's Laboratories, Factory Mutual, and the Fire Marshal.
 - 6.2.4.1. The Contractor shall provide fuel, power, maintenance, and attendance required for operation of portable heaters.
 - 6.2.4.2. Interior or exterior surfaces damaged by the use of portable heating units shall be replaced with new materials at the responsible Contractor's expense.
 - 6.2.5. It shall be the responsibility of each Contractor to protect its own Work.
- 6.3. Temporary Heating:
 - 6.3.1. Daily construction heat required after the building is enclosed shall be classified as "temporary heating" and will be the responsibility of the Mechanical Contractor to install and maintain.
 - 6.3.2. The building or buildings or any portions thereof shall be considered enclosed when in the opinion of CM:
 - 6.3.2.1. The exterior wall system and temporary interior wall enclosures are in place.
 - 6.3.2.2. Openings in exterior walls are covered to provide reasonable heat retention.
 - 6.3.2.3. The building is ready for interior drywall, masonry and plastering operations.
 - 6.3.2.4. The permanent roof is substantially installed.

The CM shall provide and maintain the temporary interior wall enclosures. If the exterior wall system is not complete in time to provide building enclosure of a portion of the new structure as scheduled, the CM shall provide and maintain temporary exterior wall enclosures of polyethylene and, in addition to exercising all other rights and remedies under the Contract Documents and law, CM shall be entitled to deduct the cost of such enclosures from the moneys due or to become due the Contractor(s) responsible for failure to meet said schedule.

- 6.3.3. In areas of the building or buildings where Work is being conducted, the temperature shall be maintained as specified in the various sections of the specifications, but not less than 50 degrees F for interior rough-in and not less than 60 degrees F during finishes installation. The temperature shall not be allowed to reach a level that will cause damage to any portion of the Work, including materials stored in the building, which may be subject to damage by low temperatures.
- 6.3.4. Until the permanent heating system, or suitable portion thereof, is in operating condition, provide sufficient and UL approved space heaters of suitable capacity to maintain required temperatures in areas where work is being conducted and materials are stored. Include all necessary maintenance, venting and attendance for this temporary heating to meet all applicable laws, rules and regulations.
- 6.3.5. When the permanent heating system, or a suitable portion thereof, is in operating condition, the system may be used for temporary heating, provided the Electrical Contractor:
 - 6.3.5.1. Obtains approval from CM in writing for its use and any special provisions required for its temporary operation.
 - 6.3.5.2. Assumes full responsibility for the entire heating system until final acceptance of the system by the Owner.
 - 6.3.5.3. Uses supply only, not return if temporary heating utilizes the building's ductwork system.
 - 6.3.5.4. Pays all costs for maintenance, attendance and restoration to "like new" condition of the system including final cleaning of equipment and ductwork and all necessary touch-up painting.
 - 6.3.5.5. Turns over satisfactory evidence to CM showing the extended warranties from manufacturers and proper maintenance procedures.
 - 6.3.5.6. Provides and maintains temporary filters, boxes and other parts used for the temporary condition and replaces same with the new permanent filters at time of occupancy consistent with the warranty provisions. The Electrical Contractor shall pay the cost of extending warranty and guarantee periods on any permanent equipment used prior to substantial completion.
- 6.3.6. Electrical power required for temporary heating will be furnished free of charge. The installation and service of the necessary temporary electrical feeders will also be the responsibility of the Electrical Contractor.

6.4. TEMPORARY ENCLOSURES

- 6.4.1. The Carpentry Contractor (or as specified in the Work Scopes) shall provide temporary (insulated) weather-tight closures of openings in exterior surfaces to provide acceptable working conditions and protection for materials, to allow for temporary heating, and to prevent entry of unauthorized persons. Provide doors with self-closing hardware and locks.
- 6.4.2. The Roofing Contractor (or as specified in the Work Scopes) shall provide temporary roofing as required to provide and maintain a watertight enclosure during construction.
- 6.4.3. The Drywall Contractor (or as specified in the Work Scopes) shall provide temporary partitions and ceilings as required to separate Work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas and to prevent damage to Owner's facilities and equipment.

END OF SECTION 01520

SECTION 01530
FIELD ENGINEERING AND LAYOUT

1 LAYOUT OF THE WORK; Each Contractor shall

- 1.1. be responsible for the layout and engineering of its own Work from the established points and lines given by a registered surveyor employed by CM and to coordinate with all other trades.
- 1.2. be responsible for detailed and accurate layout of its own and its Subordinate Parties' Work to dimension from the principal lines.
- 1.3. make provisions to preserve all control points, such as monuments, stakes, bench marks or other datum points and shall replace at its own cost any of these which might be lost or displaced through its neglect.
- 1.4. examine the conditions under which the Work is to be installed, shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Any errors, inconsistencies, omissions, discrepancies or conditions detrimental to proper performance of the Work that are discovered shall be reported to CM at once. Contractors are not to proceed until the required corrections are accomplished.

2. Verification and Documentation

- 2.1. The exactness of grades, elevations, dimensions, or locations given on any Drawings issued by Architect or the work installed by other contractors, is not guaranteed by Owner or CM.
- 2.2. In all cases of interconnection of its Work with existing or other Work, it shall verify all dimensions relating to such existing or other Work. Any errors due to the Contractor's failure to verify all such grades, elevations, dimensions, or locations shall be promptly rectified by the Contractor without any additional cost to the Owner or CM..
- 2.3. As the Work progresses, the Contractor shall prepare lay out drawings showing the exact locations of Work under its Contract as a guide to all trades. Prior to any installation, the separate Contractors shall exchange layout drawings and coordinate the Work and be subject to verification by all subsequent Contractors.
- 2.4. Each Contractor shall be responsible to take such field measurements as may be required to determine the size of ordered material. In the event "guaranteed dimensions" are required, the Contractor shall promptly advise other Contractors through CM by use of drawings, templates or mock-ups of the required conditions.
- 2.5. All Work, and in particular, piping, ducts, conduit and similar items, shall be neatly and carefully laid out to provide the most useful space utilization and the most orderly appearance. Except as otherwise indicated or directed, piping and similar Work shall be installed as close to above ceiling floor slabs and walls as conditions reasonably permit, located to prevent interference with other Work or with the use of the spaces. Before Contractor installs a valve in an exposed location, it must make all efforts to install it in an accessible, concealed location. Contractors shall carefully plan the layout and review any questionable installations with CM.
- 2.6. The Owner or CM may utilize a registered land surveyor to verify alignment and layout of certain portions of the Work. If that Work is out of tolerance or incorrect, the installing Contractor will be responsible for prompt correction of the Work to comply with the Contract Documents, along with all expenses incurred by Owner or CM in such verification process, including, but not limited to, the cost for the surveying services, as well as the additional time expended by CM personnel at standard billing rates.

END OF SECTION 01530

SECTION 01540 CUTTING AND PATCHING

1 INSPECTION

- 1.1 Before cutting, examine surfaces to be cut, including elements subject to damage or movement during cutting and patching work. Report any unsatisfactory or questionable conditions to CM in writing.
- 1.2 Before proceeding, meet at the site with CM and the parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference, conflict and possible effects on the Owner's existing operations. Coordinate procedures, temporary support, methods of dust and water protection, etc. and resolve potential conflicts before proceeding.
- 1.3 When working in and around existing buildings, if any hazardous material is encountered or is suspected to be present, immediately notify CM and stop work in this area as described in Section 00840 Hazardous Materials until further direction is given by CM or the Owner.

2 PREPARATION

- 2.1 Provide adequate temporary support to assure the structural value and integrity of the affected portion of the work. Where specified or required, submit temporary support methodologies for approval.
- 2.2 Provide devices and methods to protect adjacent areas or other portions of the Project from damage including dust protection, water protection, and exposure.
- 2.3 Maintain excavations free of water.

3 EXECUTION

- 3.1 The use of gasoline powered equipment, jackhammers or power actuated tools, explosives is prohibited on this Project.
- 3.2 Each Contractor shall:
 - 3.2.1 On behalf of itself and its Subordinate Parties be responsible for the cutting of all holes and openings through existing walls, partitions, ceilings, floors and roofs as necessary for the installation of its Work. Holes and openings shall be neatly cut and of minimum size to allow the Work to be installed. Execute cutting and demolition by methods which will prevent damage to other Work, and will provide proper surfaces to receive installation of repairs.
 - 3.2.2 Execute work in such a manner as to minimize disruptions to or interference with the Owner's normal operations or functioning in the existing buildings and provide all means necessary to provide safety and convenience of those employed in and about the premises.
 - 3.2.3 Be responsible for patching of all holes and openings it makes. Fit work should be airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces. Patching is to match adjacent surfaces in materials and finish.
 - 3.2.4 Utilize only tradesmen skilled in the specific finish and material involved in making the patches. All patching is to be done in a neat and workmanlike manner to the satisfaction of CM. Defective Work shall be corrected at no cost to the Owner and CM.
 - 3.2.5 Do all necessary cutting and fitting required to make a satisfactory connection where new Work connects with existing so as to leave the entire Work in finished and workmanlike condition. Furnish all labor and materials to this end, whether or not shown or specified. All measurements must be verified at the site.
 - 3.2.6 Employ the original installer and fabricator, when possible, to perform cutting and patching for, weather-exposed or moisture-resistant elements, sight-exposed finished surfaces.
 - 3.2.7 Execute fitting and adjustment of products to provide a finished installation to comply with the specified products, functions, tolerances and finishes.

- 3.2.8 Restore Work which has been cut or removed and shall install new products to provide completed Work in accordance with the Contract Documents. Each Contractor will be responsible to pay the appropriate contractor as designated by CM for restoring any portion of the Project that is disturbed, including but not limited to, slabs, walls, ceilings, fire rated partitions, spray-on fireproofing, and finishes, to their original state as a result of Contractor's action.
- 3.2.9 Refinish entire surfaces as the Contractor's Work scope requires providing an even finish to match adjacent surfaces and finishes, for continuous surfaces, refinishing to nearest intersection, for an assembly, and refinish the entire unit.
- 3.2.10 Be held responsible for reckless cutting of holes in slabs, walls or other finishes, or for scraping off areas of fireproofing larger or greater than that which is necessary for installation of its Work.
- 3.3 Removal and replacement of ceilings not scheduled to be replaced shall be the responsibility of the Contractor requiring access.

END OF SECTION 01540

SECTION 01550 CLEAN-UP AND FINAL CLEANING

A. SUMMARY

Execute final cleaning at completion of the Work, as required by this Section. For Contractor's daily clean-up, dust control and rubbish removal operations during construction, refer to Section 01520 Temporary Construction Controls.

a. DISPOSAL REQUIREMENTS

- i. Conduct final cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.
 - 1. Do not burn or bury rubbish and waste materials on Project site.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains.

2 PART 2 - SITE CLEAN-UP/RUBBISH REMOVAL PROCEDURE

2.1. REQUIREMENTS

2.1.1. General Contractor shall:

- 2.1.1.1. Be responsible for daily, weekly and final clean-up of its Work and the work of its Subordinate Parties as defined herein.
- 2.1.1.2. Comply with applicable labor agreements and jurisdictional rules in the hiring of laborers to perform its clean up obligations under the Contract Documents.
- 2.1.1.3. Control of dust generated by its operations on a daily basis.
- 2.1.1.4. Maintain roadways clear of all debris at all times.
- 2.1.1.5. Only use cleaning materials which will not create hazards to health or property and which will not damage surfaces. Only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned shall be used.
- 2.1.1.6. Only use sweeping compounds that do not leave residue on concrete floor surfaces and that will not affect installation of finish flooring materials

2.1.2. Dumpsters:

- 2.1.2.1. Unless stated otherwise in the Work Scopes, the CM will provide and maintain the job site dumpsters for unidentifiable debris for use as specified below.
- 2.1.2.2. Each Contractor and its Subordinate Parties shall be responsible for daily clean-up, removal and placement in dumpsters of all debris and waste resulting from its operations.
- 2.1.2.3. No overfilling of dumpsters will be allowed. All adjacent areas are to be kept clean. Excavation, demolition, masonry, drywall and hazardous waste materials are NOT to be placed in CM's dumpster.
- 2.1.2.4. Each Contractor will be responsible for removing its own excavation, demolition, masonry, drywall and Hazardous Materials from the site in strict accordance with applicable laws and regulations regarding disposal.
- 2.1.2.5. Contractor shall indemnify, defend and hold harmless the Owner and CM from claims, damages, suits, costs, or expenses of any kind (including attorney's fees and costs) arising out of, resulting from or in connection with Contractor's misuse of dumpsters.

2.1.3. Daily Clean Up. Each Contractor shall:

- 2.1.3.1. Be responsible, DAILY for the clean -up, transport and removal from the site of identifiable debris including but not limited to, bulky debris, packaging, containers, unused materials and equipment, (i.e., masonry and concrete materials, drywall, steel, crates, carton, demolition debris, other packaging, and combustible items).
- 2.1.3.2. Leave no piles of debris in the building overnight. The cost of any overtime premium required to remove debris immediately at the end of each workday shall be included in the Contractor's Work.
- 2.1.3.3. handle materials in a controlled manner so that dust and other contaminants, do not affect the Owner's or other Contractor operations and equipment
- 2.1.3.4. Be responsible to leave its Work and work area in a clean condition. This includes, but is not limited to, removal of all grease, dust, dirt, stains, labels, fingerprints and other foreign matter.
- 2.1.4. Weekly Clean Up: Each Contractor shall:
 - 2.1.4.1. While on site, provide to CM one (1) person for each five tradesmen (or portion thereof) employed at the site, one day per week, for up to four (4) hours, for the exclusive purpose of performing overall project weekly clean-up of unidentifiable debris. The cost of this (these) person(s) shall be included in Contractor's Work.
 - 2.1.4.2. Include sweeping, loading and disposal of miscellaneous debris such as mud tracked through the building, drinking cups, bottles, lunch wrappers and other unidentifiable debris. Trash and debris from this operation shall be placed in the dumpster(s)
- 2.1.5. Final Clean Up:
 - 2.1.5.1. Final clean-up, will be done at a time designated by CM.
 - 2.1.5.2. Normally, Final Clean Up will occur before punchlist inspection or prior Owner Occupancy turnover.
 - 2.1.5.3. The Contractor's duties for Final Cleaning are:
 - 2.1.5.3.1. Prior to final completion or Owner occupancy, whichever occurs first, conduct an inspection of sight-exposed interior and exterior surfaces, and all Work areas, to verify that the entire Work is left in a broom clean condition and that all Final Cleaning as set forth above has been performed.
 - 2.1.5.3.2. Tunnels and closed off spaces shall be cleaned of packing boxes, wood frame members and other waste materials used in the construction.
 - 2.1.5.3.3. Temporary labels, stickers and similar items shall be removed from fixtures and equipment. Unless otherwise directed in the technical specifications, Contractors shall not remove permanent name plates, equipment model numbers, ratings, or other items intended to be permanently affixed to the fixture or equipment.
- 2.1.6. Use of Owner's Facilities: The Owner's facilities are not to be used by Contractor for the disposal of trash or debris from its Work.
- 2.1.7. Failure to perform Clean Up:
 - 2.1.7.1. If any Contractor or its Subordinate Parties fails to maintain a satisfactory clean-up program, CM will issue written notice, to the responsible Contractor, that the necessary clean-up must be performed within twenty-four (24) hours after the notice is given. The establishment of a definite deadline for the removal of debris and rubbish will supersede the necessity for any formal notification that such work must be done.

- 2.1.7.2. If Contractor(s) fail to perform the clean-up, by the deadline, CM may perform clean-up on the Project and back charge the responsible Contractor(s) for the costs. If necessary in order to remove unidentifiable debris beyond what is removed during weekly clean up, CM will perform such clean-up and shall pro-rate the cost among the Contractors in its discretion, based on Contractor(s) type of work and manpower on site. Back charges may be deducted from the monthly invoices of the Contractor(s) and/or final payment.
- 2.1.8. Hazardous Materials: Contractors or Subordinate Parties shall dispose of Hazardous Materials in strict accordance with applicable federal, state, and local laws and regulations. Hazardous Materials may not be placed in dumpsters and/or containers not so designated for such placement.

END OF SECTION 01550

SECTION 01600 FORMS

1 USE OF FORMS

- 1.1 Upon award of the Agreement, the various forms described and referenced in the Project Manual will be provided by CM and therefore are not bound in the Project Manual. Copies of forms are available for inspection at CM Office.
- 1.2 Following is a list of the key forms:
 - 01250 Changes in the Work
 - PCO- Notice to Proceed
 - PCO- Quotation Only
 - Change Order Form (CMS.9.1 or CMS.9.2)
 - 01290 Payment Procedures
 - Application and Certificate for Payment (CON.27.1) and Continuation Sheet (CON.27.2)
 - Consent of Surety to Reduction In or Partial Release of Retainage (CON.26.6)
 - Payment schedule (PSI.10.1)
 - Payment Request for Stored Materials Form (CON.26.5)
 - Acknowledgment of Payment and Partial Unconditional Release Form (CON.26.3)
 - Unconditional Final Release and Waiver Subcontractor/Materialman Form (CON.26.4)
 - Sworn Statement Form (CON.26.2)
 - 01320 Communications
 - Trade Contractors Daily/Pre-Task Plan (CON.14.4)
 - Request for Information Form (CON.25.2) (in company approved software, if necessary)
 - 01330 Submittals
 - BMC Submittal Transmittal Form (CON.9.6)
 - 01400 Quality Requirements
 - Corrective Action Report (CAR)/Notice of Non-Conformance (NCR) (CON.18.2)
 - 01700 Contract Close-out
 - Consent of Surety Company to Final Payment Form (CON.26.7)
 - Consent of Surety to Reduction in or Partial Release of Retainage Form (CON.26.6)
 - Certificate of Contract Completion Form (CLO.7.5)
 - 01720 Project Record Documents
 - Closeout Submittal (CLO.7.2)
 - 01740 Warranties and Guarantees
 - Contractor's Guarantee (CLO.7.3)
 - 01750 Systems Demonstration, Training and Start-up
 - Equipment/Systems Acceptance Form (CLO.2.1)
 - Owner Training Register (CLO.2.2)

END OF SECTION 01600

**SECTION 01630
PRODUCT SUBSTITUTIONS**

1. WORK INCLUDED

- 1.1. Furnish and install Products specified, under options and conditions for substitutions stated in this Section.

2. BIDDER'S OPTIONS

- 2.1. For products that are specified only by reference standard, select Product meeting that is standard by any manufacturer.
- 2.2. For Products specified by naming several Products or manufacturers, select any one of products and manufacturers named which complies with Specifications.
- 2.3. For Products specified by naming several Products or manufacturers and stating "or equivalent", or "or equal", or "or Architect approved equivalent", or similar wording, submit a request as for substitutions, for any Product or manufacturer which is not specifically named for review and approval by the Architect.
- 2.4. For Products specified by naming only one Product and manufacturer, there is no option and no substitution will be allowed.

3. SUBSTITUTION PROCESS

3.1. SUBSTITUTIONS

- 3.1.1. Base Bid shall be in accordance with the Contract Documents.
- 3.1.2. Substitutions for products may be made during the bidding period by submitting completed Substitution Request Form and substantiating product data/literature a minimum of ten (10) Days prior to Bid date to CM who will then forward to the Architect.
- 3.1.2.1. Architect will consider requests from the Bidder for substitution of products in place of those specified as set forth in this section.
- 3.1.2.2. Those submitted the specified calendar days prior to Bid Date will be included in an addendum if acceptable.
- 3.1.2.3. After the end of the bidding period, requests will be considered only in case of Product unavailability or other conditions beyond the control of Contractor.
- 3.1.2.4. Bid Proposals shall not be based on assumed acceptance of any item which has not been approved by addendum.
- 3.1.3. Bidders are required to submit a separate Substitution Request Form for each proposed substitution. Each substitution request should be accompanied by the following supporting documentation:
- 3.1.3.1. A full explanation of the proposed substitution.
- 3.1.3.2. Complete data substantiating compliance of the proposed substitution with the requirements stated in the Contract Documents.
- 3.1.3.2.1. Product identification, including the manufacturer's name and address.
- 3.1.3.2.2. Manufacturer's literature; identifying:
- 3.1.3.2.2.1. Product description and technical information.
- 3.1.3.2.2.2. Reference standards.
- 3.1.3.2.2.3. Performance and test data.
- 3.1.3.2.2.4. Installation instructions, operating procedures and other like information.
- 3.1.3.2.3. Samples, as applicable.

- 3.1.3.2.4. Names and addresses of similar projects on which product has been used, and date of each installation.
 - 3.1.3.3. Itemized comparison of the proposed substitution with the product specified, listing all significant variations.
 - 3.1.3.4. Data relating to changes in delivery or construction schedule.
 - 3.1.3.5. A list of all effects of the proposed substitution on separate contracts.
 - 3.1.3.6. Accurate cost data comparing the proposed substitution with the product specified.
 - 3.1.3.6.1. Amount of any net change to Contract Sum.
 - 3.1.3.7. Designation of required license fees or royalties.
 - 3.1.3.8. Designation of availability of maintenance services and sources of replacement materials.
 - 3.1.4. Substitutions will not be considered for acceptance when:
 - 3.1.4.1. They are indicated or implied on shop drawings or product data submittals without a formal request from Bidder.
 - 3.1.4.2. Acceptance will require substantial revision of Contract Documents.
 - 3.1.4.3. In judgment of Architect, do not include adequate information necessary for a complete evaluation.
 - 3.1.4.4. If requested after Contract Award directly by a subcontractor or supplier, except for special or unusual circumstances reviewed by the Contractor with CM.
 - 3.1.5. Substitute products shall not be ordered or installed without written acceptance of Architect.
 - 3.1.6. Architect will determine acceptability of proposed substitution.
- 3.2. BIDDER'S REPRESENTATION
- 3.2.1. In making formal request for substitution the Bidder represents that:
 - 3.2.2. It has investigated the proposed product and has determined it is equivalent to or superior in all respects to the product specified.
 - 3.2.3. It will provide same warranties or bonds for the proposed substitution as required for the product specified.
 - 3.2.4. It will coordinate installation of the accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.
 - 3.2.5. It waives all claims for additional costs caused by or arising from the substitution which may subsequently become apparent.
 - 3.2.6. Cost data is complete and includes related costs under its Agreement, but not:
 - 3.2.6.1. Costs under separate contracts.
 - 3.2.6.2. Architect's costs for redesign or revision of Contract Documents.
 - 3.2.7. Cost data need not be submitted, if request is for inclusion in an addendum. Requests after the Agreement is awarded shall contain a complete cost comparison.
 - 3.2.8. Any modifications necessary as a result of the use of an approved substitute shall be paid by the Contractor proposing the substitution.
 - 3.2.9. Any additional engineering costs required to be performed by the Architect to approve, implement or coordinate the substitution above reasonable review services, shall be paid by the Contractor proposing the substitution.

- 3.2.10. Under no circumstances will the Architect be required to prove that a product proposed for substitution is or is not equal to the quality of the product specified.

3.3. ARCHITECT'S DUTIES

- 3.3.1. Review requests for substitutions with reasonable promptness.
- 3.3.2. Coordinate review/approval of "Architect Approved" substitutions with the Owner prior to notifying the CM.
- 3.3.3. Issue a written instruction of decision to accept the substitution.
- 3.3.4. Substitution requests that are not approved will be returned to the party submitting the request with an explanation for the rejection.

3.4. SUBSTITUTION REQUEST FORM

- 3.4.1. The form is attached to this Section.
- 3.4.2. SUBSTITUTIONS WILL BE CONSIDERED ONLY WHEN THE ATTACHED FORM IS COMPLETED AND INCLUDED WITH THE SUBMITTAL WITH ALL BACKUP DATA.

SUBSTITUTION REQUEST FORM

TO: Barton Malow Company

We hereby submit for your consideration the following product instead of the specified item for the above Project:

DRAWING NO.: _____ **DRAWING NAME:** _____

SPEC. SECT.	SPEC. NAME	PARAGRAPH	SPECIFIED ITEM
_____	_____	_____	_____

Proposed Substitution:

Attached complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

Submit with request all necessary samples and substantiating data to prove equal quality and performance to that which is specified. Clearly mark manufacturer's literature to indicate equality in performance.

CERTIFICATION OF EQUAL PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUAL PERFORMANCE

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted by:

Signature_____
Title_____
Firm_____
Address_____
Telephone_____
Date

Signature shall be by person having authority to legally bind his/her firm to the above terms. Failure to provide legally binding signature will result in retraction of approval.

For use by Architect

____Accepted ____Accepted as noted

____Not accepted ____Received too late

____Insufficient data received

By: _____

Date: _____

For use by Owner

____Accepted ____Accepted as noted

____Not accepted ____Received too late

____Insufficient data received

By: _____

Date: _____

Fill in blanks below (attach additional sheets as required):

A. Does the Substitution affect dimensions shown on Drawings?

Yes _____ No _____ If yes, clearly indicate changes: _____

B. Will the undersigned pay for changes to the building design, including engineering and detailing costs caused by the requested substitution?

Yes _____ No _____ If no, fully explain: _____

C. What affect does substitution have on other contracts or other trades?

D. What affect does substitution have on the delivery and construction schedule? _____

E. Manufacturer's warranties of the proposed and specified items are: Same _____ Different _____

If different, explain on an attachment.

F. Reason for Request: _____

G. Itemized comparison of specified item(s) with the proposed substitution; list significant variations:

H. Accurate cost data comparing proposed substitution with product specified:

I. This substitution will amount to a credit or an extra cost to the Owner of:

_____ Dollars

(\$ _____)

END OF SECTION 01630

SECTION 01700 CONTRACT CLOSE-OUT

1. CLOSE-OUT PROCEDURE

- 1.1. The following procedure and forms will be used to sequentially progress through the contract close-out stage in a productive and timely manner.

1.1.1. PREPARATION FOR CONTRACT CLOSE-OUT

During the course of the Project, the Contractor will thoroughly review the Contract Documents as it relates to the requirements and obligations and gather and submit to CM the proper submittals, shop drawings, material certifications, waivers, certificates of insurance, bonds, and other contractual requirements impacting contract close-out.

1.1.2. INITIATING THE FINAL CLOSE-OUT PROCESS

When nearing 75% completion of the Work, the Contractor will review the status of the Close-Out process with CM. The Contractor's contractual responsibilities will be reviewed and outstanding close-out and other submittals identified.

1.1.3. OBTAINING THE CERTIFICATE OF SUBSTANTIAL COMPLETION

As the Contractor is nearing the completion of the Work and after concurrence with CM, it shall submit a written request for Substantial Completion, all required documentation as outlined, and a listing of all minor deficiencies yet to be completed.

The following documents are the minimum required at the time of request for Substantial Completion. Contractor shall also submit all additional documentation as required in the Contract Documents:

- 1.1.3.1. AIA G704 Certificate of Substantial Completion
- 1.1.3.2. As-built records
- 1.1.3.3. Operation and Maintenance Manuals
- 1.1.3.4. Keys, Maintenance Stock, and Spare Parts
- 1.1.3.5. Test and Start-up/Owner Training Sessions
- 1.1.3.6. Submission of Permits and Approvals (i.e. Fire Marshal, Department of Public Health Approvals, etc.)
- 1.1.3.7. Guarantee and Warranties
- 1.1.3.8. Punchlist (list of work to be completed or corrected)

Once CM has received all required documents they will be forwarded to the Architect and Owner. CM will review the Contractor's request for Substantial Completion; all above documentation, and list of deficiencies, add appropriate comments, and forward to the Architect and/or Owner for review. In conjunction with the Contractor, CM will establish a schedule for the completion of all listed items, which in no event shall exceed any time periods established in the Contract Documents for Final Completion.

When the Architect determines that the Work is substantially complete, the Certificate of Substantial Completion shall be issued to the Contractor.

1.1.4. CONTRACTOR COMPLETES PUNCHLIST WORK

Each Contractor shall submit a letter certifying all punchlist items are completed, in a manner acceptable to the Owner, CM and the Architect.

1.1.5. FINAL INSPECTION NOTICE

Each Contractor is to forward (**written notice and accompanying documentation**) to CM that Work is ready for final inspection and acceptance. CM will forward written notice to the Architect if CM is in agreement that Work is complete. The Architect will perform a final inspection and sign off on the punchlist form if Work is in fact completed. If punchlist work is not found complete, the Contractor shall take action to remedy any insufficiencies and then shall re-submit the written notice and accompanying documentation that Work is ready for **final** inspection and acceptance. If CM and/or Architect are required to perform more than 2 site visits to determine Substantial or Final Completion of Contractor's Work, the costs for such additional inspections shall be charged to Contractor.

The following documents are the minimum required to complete final payment. Contractor shall also submit all additional documentation as required in the Contract Documents:

- 1.1.5.1. Final Payment Request (on G702 & G703).
- 1.1.5.2. Guarantees/Warranties (including subs and suppliers).
- 1.1.5.3. Final Sworn Statements (including subs and suppliers).
- 1.1.5.4. Acknowledgment of Payment and Partial Unconditional Release
- 1.1.5.5. Final Release Subcontractor/Materialman
- 1.1.5.6. Certified Payroll Report (projects governed by prevailing wage laws)
- 1.1.5.7. Verification of Rate Classification and Payment (Federal projects)
- 1.1.5.8. Consent of Surety Company to Final Payment (AIA G707)
- 1.1.5.9. Consent of Surety to Reduction or Partial Release of Retainage (AIA G707A)
- 1.1.5.10. Certificate of Substantial Completion (on G704).
- 1.1.5.11. Completion and acceptance of all punchlist Work.

Items 1.1.5.2 through 1.1.5.5 must always be submitted with the final request for payment.

1.1.6. REVIEW OF FINAL PAYMENT REQUEST

CM and the Architect will review the Contractor's final payment request and Close-Out file. If all administrative documents are attached or have been submitted (i.e. guarantee, warranty, waiver of lien, etc.), all Work is complete, and all other responsibilities are met, the Project Team will forward the Contractor's Application for Final Payment to the Owner and payment shall be processed according to the Owner's regular procedures.

2. FINAL COMPLETION

- 2.1. To attain final completion, the Contractor shall complete activities pertaining to Substantial Completion, and complete Work on punch list items. Only then shall it issue written request to CM to conduct a site visit to determine Final Completion.
- 2.2. When Contractor considers the Work is finally complete, it shall submit written certification that:
 - 2.2.5. Contract Documents have been reviewed.
 - 2.2.6. Work has been inspected for compliance with Contract Documents.
 - 2.2.7. Work has been completed in accordance with Contract Documents.
 - 2.2.8. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 - 2.2.9. Work is completed and ready for final observation.
- 2.3. CM and/or Architect will make an observation to verify the status of completion with reasonable promptness after receipt of such certification.
- 2.4. Should CM and/or Architect consider that the Work is incomplete or defective:

- 2.4.5. CM will promptly notify the Contractor in writing, listing the incomplete or defective Work.
 - 2.4.6. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to the CM that the Work is complete.
 - 2.4.7. CM and/or Architect will re-inspect the Work.
 - 2.5. When CM and/or Architect determines that the Work is acceptable under the Contract Documents, it shall request the Contractor to make close-out submittals.
3. CONTRACTOR'S CLOSE-OUT SUBMITTALS
- 3.1. Evidence of compliance with requirements of governing authorities (state, local or federal):
 - 3.1.5. Certificates of Inspection:
 - 3.1.5.1. Mechanical
 - 3.1.5.2. Electrical
 - 3.1.5.3. Others as required
 - 3.2. Project Record Documents: Refer to requirements of Section 01720.
 - 3.3. Operating and Maintenance Data, Instructions to Owner's Personnel: Refer to requirements of Section 01730.
 - 3.4. Warranties and Bonds: Refer to requirements of Individual Sections and Individual Technical Specifications and Section 01740.
 - 3.5. Spare Parts and Maintenance Materials: Refer to requirements of Individual Technical Specifications.
 - 3.6. Evidence of Payment and Release of Liens: Refer to requirements of General and Supplementary Conditions and Section 01290.

END OF SECTION 01700

**SECTION 01720
PROJECT RECORD DOCUMENTS**

1 SUMMARY

- 1.1 Each Contractor shall be responsible to maintain at the job site one copy of:
 - 1.1.1 Record Contract Drawings
 - 1.1.2 Record Project Manual
 - 1.1.3 Addenda
 - 1.1.4 Reviewed/Approved Shop Drawings
 - 1.1.5 Change Orders
 - 1.1.6 Other modifications to Contract
 - 1.1.7 Field test records
 - 1.1.8 Affidavits
- 1.2 Store documents apart from documents used for construction.
- 1.3 Maintain documents in clean, dry, legible condition.
- 1.4 Do not use project record documents for construction purposes.
- 1.5 Make documents available for inspection by the Owner, CM and the Architect.
- 1.6 Failure to maintain documents up-to-date will be cause for withholding payments to Contractor.
- 1.7 At the outset of the project, obtain from the Architect through the CM, at no charge to the Contractor, one complete set of Contract Documents including:
 - 1.7.1 Technical Specifications with all addenda.
 - 1.7.2 One complete set of prints of all Drawings.

2 RECORDING

- 2.1 Label each document "Project Record."
- 2.2 Keep record documents current.
- 2.3 Do not permanently conceal any work until required information has been recorded.
- 2.4 Contract Drawings:
 - 2.4.1 Contractor may at his option enter required information on a "working set" and then at completion of Project transfer the information to final submitted "Project Record" set.
 - 2.4.2 Contractor shall legibly mark to record actual construction:
 - 2.4.2.1 Depths of various elements of foundation in relation to survey data.
 - 2.4.2.2 Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 - 2.4.2.3 Location and depths of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - 2.4.2.4 Field changes of dimension and detail.
 - 2.4.2.5 Changes made by PCO- Notice to Proceed.

2.4.2.6 Details not on original Contract Drawings.

2.5 Technical Specifications and Addenda:

2.5.1 Contractor shall legibly mark up each section to record:

2.5.1.1 Manufacturer, trade name, catalog number and Supplier of each product and item of equipment actually installed.

2.5.1.2 Changes made by PCO- Notice to Proceed.

2.5.1.3 Other items not originally specified.

2.6 Conversion of Schematic Layouts:

2.6.1 Arrangement of conduits, circuits, piping, ducts and similar items are in most cases shown schematically on the Drawings.

2.6.2 Contractor shall legibly mark to record actual construction:

2.6.2.1 Dimensions accurate to within 1" of the center of items shown schematically.

2.6.2.2 Identify each item, for example, "cast iron drain", "galvanized water", etc.

2.6.2.3 Identify location of each item, for example, "under slab", "in ceiling plenum", "exposed", etc.

2.6.3 The Owner, Architect or CM may waive requirements of schematic layout conversion, when in their opinion, it serves no beneficial purpose. Do not, however, rely on waivers being issued except as specifically issued by the CM in written form.

3 SUBMITTAL

3.1 At completion of Project deliver, 1 set of electronic sets of Record Documents, in a format acceptable to the Owner and the Architect, using the Final Document Submittal Form (in Section 01600 Forms), to CM prior to request for final payment.

3.2 Accompany submittal with transmittal letter, in duplicate, containing:

3.2.1 Date

3.2.2 Project title and number

3.2.3 Contractor's name and address

3.2.4 Title and number of each record document

3.2.5 Certification that each document as submitted is complete and accurate.

3.2.6 Signature of Contractor, or his authorized representative.

END OF SECTION 01720

SECTION 01730
OPERATIONS AND MAINTENANCE DATA

1. SCOPE

- 1.1. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.
- 1.2. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of the Technical Specifications.
- 1.3. Instruct Owner's personnel in maintenance of products and in operation of equipment and systems in accordance with the requirements in Section 01750 Systems Demonstration, Training and Start-up.

2. QUALITY ASSURANCE

- 2.1. Preparation of data shall be done by personnel:
 - 2.1.1. Trained and experienced in maintenance and operation of described products.
 - 2.1.2. Familiar with requirements of this Section.
 - 2.1.3. Skilled as technical writer to the extent required to communicate essential data.
 - 2.1.4. Skilled as draftsman competent to prepare required drawings.

3. FORM OF SUBMITTALS

- 3.1. Prepare data in the form of an instructional manual for use by Owner's personnel.
- 3.2. Format:
 - 3.2.1. Size: 8-1/2" x 11"
 - 3.2.2. Paper: white, for typed pages.
 - 3.2.3. Text: Manufacturer's printed data, or neatly typewritten.
 - 3.2.4. Drawings:
 - a. Provide reinforced punched binder tab, bind in with text.
 - b. Fold larger drawings to size of text pages.
 - 3.2.5. Provide fly-leaf for each separate product, or each piece of operating equipment.
 - c. Provide typed description of product, and major component parts of equipment.
 - d. Provide indexed tabs.
 - 3.2.6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS." list:
 - e. Title of Project
 - f. Identity of separate structures as applicable.
 - g. Identity of general subject matter covered in the manual.
- 3.3. Binders:
 - 3.3.1. Commercial quality three-ring binders with durable and cleanable plastic covers.
 - 3.3.2. Maximum ring size: 3"
 - 3.3.3. When multiple binders are used, correlate the data into related consistent groupings.

4. CONTENT OF MANUAL

- 4.1. Neatly typewritten table of contents for each volume, arranged in systematic order.

- 4.1.1. Contractor, name of responsible principal, address and telephone number.
- 4.1.2. A list of each product required to be included, indexed to content of the volume.
- 4.1.3. List with each product, name, address and telephone number of:
 - a. Subcontractor or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Identify area of responsibility of each.
 - d. Local source of supply for parts and replacement.
- 4.1.4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
- 4.2. Product Data:
 - 4.2.1. Include only those sheets which are pertinent to the specific product.
 - 4.2.2. Annotate each sheet to:
 - e. Clearly identify specific product or part installed.
 - f. Clearly identify data applicable to installation.
 - g. Delete references to inapplicable information.
- 4.3. Drawings:
 - 4.3.1. Supplement product data with drawings as necessary to clearly illustrate:
 - b. Relations of component parts or equipment and systems.
 - c. Control and flow diagrams.
 - 4.3.2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - 4.3.3. Contractor may use Project Record Documents as maintenance drawings - coordinate with CM.
- 4.4. Written text, as required to supplement product data for the particular installation:
 - 4.4.1. Organize in consistent format under separate headings for different procedures.
 - 4.4.2. Provide logical sequence of instructions for each procedure.
- 4.5. Copy of each warranty, bond and service contract issued.
 - 4.5.1. Provide information sheet for Owner's personnel, give:
 - a. Proper procedures in event of failure.
 - b. Instances which might affect validity of warranties or bonds.
- 5. MANUAL REVIEW AND PREPARATION SCHEDULE
 - 5.1. Submit two copies of preliminary draft of proposed formats and outlines of contents to CM prior to start of preparation.
 - 5.1.1. Architect will review draft and return one copy with comments.
 - 5.2. Submit 1 set of electronic copy of completed data in final form to the CM at least 2 months before the end of the project, for Owner review.
 - 5.2.1. Copy will be returned after final inspection or acceptance, with comments.
 - 5.3. Submit copies of completed operation and maintenance manuals at least two (2) weeks before execution and have at hand for use in demonstrations and instructions.

- 5.4. Submit specified number of copies of approved data in final form to the CM ten (10) days after final inspection or acceptance.

6. PRODUCTS

6.1. MANUAL FOR MATERIALS AND FINISHES

- 6.1.1. Submit 1 electronic copy of complete manual in final form.
- 6.1.2. Content, for architectural products, applied materials and finishes:
 - 6.1.2.1. Manufacturer's data, giving full information on products.
 - 6.1.2.1.1. Catalog number, size, and composition.
 - 6.1.2.1.2. Color and texture designations.
 - 6.1.2.1.3. Information required for reordering special-manufactured products.
 - 6.1.2.2. Instructions for care, maintenance and preventative maintenance.
 - 6.1.2.2.1. Manufacturer's recommendation for types of cleaning agents and methods.
 - 6.1.2.2.2. Cautions against cleaning agents and methods which are detrimental to product.
 - 6.1.2.2.3. Recommended schedule for cleaning and maintenance.
- 6.1.3. Content, for moisture-protection and weather-exposed products:
 - 6.1.3.1. Manufacturer's data, giving full information on products.
 - 6.1.3.1.1. Applicable standards.
 - 6.1.3.1.2. Chemical composition.
 - 6.1.3.1.3. Details of installation.
 - 6.1.3.2. Instructions for inspection, maintenance and repair.
- 6.1.4. Additional requirements for maintenance data: Reference sections of Technical Specifications.

6.2. MANUAL FOR EQUIPMENT AND SYSTEMS

- 6.2.1. Submit 1 electronic copy of complete manual in final form.
- 6.2.2. Content, for each unit of equipment and system, as appropriate:
 - 6.2.2.1. Description of unit and component parts.
 - 6.2.2.1.1. Function, normal operating characteristics, and limiting conditions.
 - 6.2.2.1.2. Performance curves, engineering data and tests.
 - 6.2.2.1.3. Complete nomenclature and commercial number of replaceable parts.
 - 6.2.2.2. Operating procedures:
 - 6.2.2.2.1. Start-up, break-in, routine and normal operating instructions.
 - 6.2.2.2.2. Regulation, control, stopping, shutdown and emergency instructions.
 - 6.2.2.2.3. Summer and winter operating instructions.
 - 6.2.2.2.4. Special operating instructions.
 - 6.2.2.3. Maintenance and Preventative Maintenance Procedures:
 - 6.2.2.3.1. Routine operations.
 - 6.2.2.3.2. Guide to "trouble-shooting".

- 6.2.2.3.3. Disassembly, repair and re-assemble.
 - 6.2.2.3.4. Alignment, adjusting and checking.
 - 6.2.2.4. Servicing and lubrication schedule.
 - 6.2.2.4.1. List of lubricants required.
 - 6.2.2.5. Manufacturer's printed operating and maintenance instructions.
 - 6.2.2.6. Description of sequence of operation by control manufacturer.
 - 6.2.2.7. Original manufacturer's parts, list, illustrations, assembly drawings and diagrams required for maintenance.
 - 6.2.2.7.1. Predicted life of parts subject to wear.
 - 6.2.2.7.2. Items recommended to be stocked as spare parts.
 - 6.2.2.8. As-installed control diagrams by controls manufacturer.
 - 6.2.2.9. Each Contractor's coordination drawings.
 - 6.2.2.9.1. As-installed color coded piping diagrams.
 - 6.2.2.10. Charts of valve tag numbers, with location and function of each valve.
 - 6.2.2.11. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 - 6.2.2.12. Other data as required under pertinent sections of specifications.
- 6.2.3. Content, for each electric and electronic system, as appropriate:
 - 6.2.3.1. Description of system and component parts.
 - 6.2.3.1.1. Function, normal operating characteristics and limiting conditions.
 - 6.2.3.1.2. Performance curves, engineering data and tests.
 - 6.2.3.1.3. Complete nomenclature and commercial number of replaceable parts.
 - 6.2.3.2. Circuit directories of panel boards.
 - 6.2.3.2.1. Electrical service.
 - 6.2.3.2.2. Controls.
 - 6.2.3.2.3. Communications.
 - 6.2.3.3. As-installed color coded wiring diagrams.
 - 6.2.3.4. Operating procedures:
 - 6.2.3.4.1. Routine and normal operating instructions.
 - 6.2.3.4.2. Sequences required.
 - 6.2.3.4.3. Special operating instructions.
 - 6.2.3.5. Maintenance and preventative maintenance procedures:
 - 6.2.3.5.1. Routine operations.
 - 6.2.3.5.2. Guide to "trouble-shooting".
 - 6.2.3.5.3. Disassembly, repair and re-assemble.
 - 6.2.3.5.4. Adjustment and checking.
 - 6.2.3.6. Manufacturer's printed operating and maintenance instructions.

- 6.2.3.7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- 6.2.3.8. Other data as required under pertinent sections of specifications.
- 6.2.4. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
- 6.2.5. Additional requirements for operating and maintenance data: Reference sections of Technical Specifications.

END OF SECTION 01730

SECTION 01740 WARRANTIES AND GUARANTEES

1 GENERAL

- 1.1 Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

2 WARRANTY REQUIREMENTS

- 2.1 Deliver all written warranties and guarantees required by the Contract Documents with the Owner named as beneficiaries. All warranties shall include labor and materials, shall be signed by the manufacturer or subcontractor as the case may be, and countersigned by the Contractor. All written warranties shall be addressed to the Owner and delivered to CM upon completion of the Project, before or with the submission of Request for Final Payment.
- 2.2 In addition to all other warranties set forth in the Contract Documents or imposed by applicable law, Contractor warrants to Owner and CM that the Work will be free from defects and performed in strict conformity with the requirements of the Contract Documents. This warranty survives the termination of the Agreement and shall only be extinguished by limitation periods imposed by applicable law and shall not be limited by any other provisions contained in the Agreement, including any provisions or time periods related to Contractor's obligation to correct defective Work.
- 2.3 Contractor, upon signing the Agreement, shall obtain and forward to CM any and all Standard Product Warranties for products, materials and systems covered under its Agreement. The Manufacturer's warranties do NOT relieve the Contractor from its warranty obligations under the Contract Documents.
- 2.4 Special Warranties shall become effective on a date established by the Project Team. This date generally shall be the date of Final Completion of the Project or Substantial Completion of the Project or portions thereof as agreed upon by the Project Team. In the case of acceptance of a portion of the Work or Project, separate warranties shall be issued for those specific portions of the Project that were accepted, and shall be dated the date the specific portion was accepted. As additional Work is accepted, separate warranties for those specific portions of the Work shall be issued and properly dated. Issuance of warranties for a portion of the Work shall in no way become the basis for Application for Final Payment.
- 2.5 If for any reason, the Bidder cannot warrant any part of the Work using products, materials, or construction methods that have been specified or shown, it shall notify CM in writing at least ten (10) days before the bid submission date, giving reasons together with the names of products and data on substitutions it can guarantee. Should the Bidder fail to so notify CM within this time period, it will be bound to all warranties and guarantees as set forth in the Contract Documents.
- 2.6 Related Damages and Losses: In correcting Work that has been rejected as defective or otherwise failing to conform to the Contract Documents, whether before or after Substantial Completion, Contractor shall bear all related costs, including, but not necessarily limited to, the cost to correct the Work, the cost to correct all other Work that has been damaged by the defective or non-conforming Work, or that is damaged in the process of correcting the defective or nonconforming Work, and the cost of all additional testing and inspections and compensation for the Architect and/or CM's services and expenses made necessary thereby.
- 2.7 Reinstatement of Warranty: When Work covered by a warranty with a specific time period has failed and has been corrected by Contractor, the warranty shall be reinstated for a time period equal to the original warranty.
- 2.8 Express warranties are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available to the Owner or CM under the law. Express warranty periods shall not be interpreted as limitations on the time in which Owner or CM may enforce Contractor's duties and obligation or their rights and remedies under the Agreement and applicable law.

2.08.1 Rejection of Warranties: The Owner and CM reserve the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

2.9 Where the Contract Documents require a Special Warranty, or similar commitment on the Work or part of the Work, the Owner and CM reserve the right to refuse to accept the Work, until the Contractor presents evidence that the entities required to countersign such commitments are willing to do so.

3 SUBMITTALS

- 3.1 Submit electronic copies of the warranties to the CM within fourteen (14) days of Substantial Completion using the form found in section 01600-Forms and organizing the warranty documents into an orderly sequence based on the table of contents of the Project Manual. If the project Team's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of CM.
- 3.2 When the Contract Documents require Contractor, or Contractor and a Subordinate Party to execute a Special Warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the CM for approval prior to final execution.
- 3.3 Forms for warranties are included in Section 01600-Forms. Prepare a written document utilizing the appropriate form, ready for execution by Contractor and its Subordinate Party(ies). Submit a draft to CM for approval prior to final execution.

END OF SECTION 01740

SECTION 01750
SYSTEMS DEMONSTRATION, TRAINING AND START-UP

2 GENERAL

- 2.1 COORDINATE Procedures for demonstration of equipment operation and instruction of Owner's personnel through CM.

3 QUALITY ASSURANCE

- 3.1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstrations and instructions have been completed.
- 3.2 CM will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

4 SUBMITTALS

- 4.1 Submit preliminary schedule to CM for Architect's and Owner's approval, listing times and dates for demonstration of each item of equipment and each system, at least two (2) weeks prior to proposed dates.
- 4.2 Submit electronic copies of the reports within one week after completion of demonstrations, that demonstrations and instructions have been satisfactorily completed. Give time and date of each demonstration, and hours devoted to demonstration, with a list of persons present.

5 PREPARATION

- 5.1 Provide substantiating information that verifies equipment has been inspected and put into operation; testing, adjusting, and balancing has been performed; and equipment and systems are fully operational.
- 5.2 Submit copies of completed operation and maintenance manuals at least two (2) weeks before execution and have at hand for use in demonstrations and instructions.
- 5.3 CM will develop a schedule for the system demonstration, training, start-up and turn over of all systems and equipment.

6 DEMONSTRATION AND INSTRUCTIONS

- 6.1 Demonstrate operation and maintenance of equipment and systems to the Owner's, CM's and Architect's personnel two (2) weeks prior to date of final inspection. For equipment requiring seasonal operation, perform instructions for other seasons within six months. Contractor shall document the testing, equipment start-up and training sessions as required using the following forms in Section 01600 Forms:
- 6.1.1 Equipment/System Acceptance - This form will be completed for each piece of equipment or system for each contract that requires operational testing and/or training before acceptance. This will document the date of testing, the equipment tested, names of personnel which witnessed the testing and acceptance.
- 6.1.2 Owner Training Register - This form will be completed for each contract that requires training to be provided to the Owner's personnel. This will document the date of training, type of training, names of the personnel trained and acceptance of the training.
- 6.2 The amount of time required for instruction on each item of equipment and system is that specified in individual sections or as mutually agreed upon between Contractor and CM.
- 6.3 Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.
- 6.4 Use operation and maintenance manuals as basis of instruction and review the contents of the manuals with personnel in full detail to explain all aspects of operations and maintenance.
- 6.5 Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

- 6.6 Contractor is responsible for video taping the training sessions. The videotape should be of professional quality and the Owner should be provided with three (3) copies of the videotape.

END OF SECTION 01750

PROJECT MANUAL FOR THE CONSTRUCTION OF:

PROJECT:

2013 BOND PROGRAM

LARSON MIDDLE SCHOOL REMODELING (13171A)
INTERNATIONAL ACADEMY EAST REMODELING (13175C)

BID PACKAGE NO. 19

OWNER:

TROY SCHOOL DISTRICT
4400 Livernois
Troy, Mi. 48098

TMP PROJECT NOS.: 13171A and 13175C

DATE: FEBRUARY 14, 2017

ISSUED FOR BIDS

ARCHITECT

TMP ARCHITECTURE, INC.
1191 West Square Lake Road
Bloomfield Hills, Michigan 48302-0374

PH (248) 338-4561
FX (248) 338-0223
Email info@tmp-architecture.com

STRUCTURAL ENGINEER

DESAI/NASR CONSULTING ENGINEERS
6765 Daly Rd.
West Bloomfield, Michigan 48332

PH (248) 932-2010
FX (248) 932-3088
Email info@desainasr.com

CONSTRUCTION MANAGER

BARTON MALOW COMPANY
26500 American Drive
Southfield, Mi. 48034

PH (248) 436-5000
FX (248) 436-5001
Email info@bartonmalow.com

MECHANICAL & ELECTRICAL ENGINEER

PETER BASSO ASSOCIATES, INC
5145 Livernois, Suite 100
Troy, Michigan 48098

PH (248) 879-5666
FX (248) 879-0007
Email info@pbanet.com

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****END OF SECTION****

AVAILABILITY OF ELECTRONIC FILES

PART 1 – GENERAL

1.1 POLICY

- A. As a service to contractors, subcontractor, vendors, material suppliers and others needing electronic copies of drawing files, the Architect will provide CAD files electronically in accordance with the following policy:
1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
 2. It is further understood and agreed that the undersigned will hold TMP Architecture harmless and indemnify TMP Architecture from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
 3. It is understood and agreed that the items transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD version 2009 dwg files.
 4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
 5. As a record of information to be transmitted, TMP Architecture will prepare a duplicate electronic back-up for its record.
 6. Compensation for providing this material will be as follows:
 - a. Base Fee of \$250 for 1 to 3 drawings.
 - b. Base Fee of \$500 for 4 to 10 drawings.
 - c. For each additional drawing after 10 the fee is \$40.00 per drawing (i.e., 11 drawings = \$540).
 7. Payment must be provided along with a signed copy of the Release Letter before files will be released.

1.2 REQUEST PROCEDURE

- A. To receive files the attached Release Letter must be completed in full and submitted to the Construction Manager to be forwarded to the Project Manager at TMP Architecture.
1. A signed copy of the Release Letter must be submitted; faxed or emailed copies will be accepted.
 2. Upon remittance of the signed Release Letter and Fee, allow five working days for processing.
 3. Transmission of documents will be provided electronically after the receipt of payment.

Date: _____

Firm Requesting Files:

Name: _____

Company: _____

Address: _____

City, State, Zip: _____

Re: Letter of Authorization for CAD File Transfers

Project Name: _____

TMP Project No. : _____ Bid Pack No. : _____

Dear Sir:

Per your request, TMP Architecture will transmit the requested CAD files in the form of CD-ROM upon receipt of an original signed copy of this letter with conditions of agreement as stated.

1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
2. It is further understood and agreed that the undersigned will hold TMP Architecture harmless and indemnify TMP Architecture from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
3. It is understood and agreed that the items transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD 2009.
4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
5. As a record of information to be transmitted, we will prepare a duplicate back-up for our files, which may be electronic or hard-copy.
6. Compensation for providing this material will be as follows: Base Fee of \$250 for 1 to 3 drawings and a Base Fee of \$500 for 4 to 10 drawings; for each additional drawing after 10 the fee is \$40.00 per drawing (i.e., 11 drawings = \$540). Payment must be provided along with a signed copy of this form before files will be released. Please remit to TMP Architecture and allow five working days for processing.

Fee: \$_____ Drawings: _____

Signed: _____ Printed Name/Title: _____

Firm Requesting: _____

Phone: _____ Fax: _____

To Be Completed By TMP Architecture, Inc.

Released (signed by): _____ TMP Architecture, Inc.

Printed Name/Title: _____ Date: _____

****END OF SECTION****

ALTERNATES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF REQUIREMENTS:

- A. Definition: An alternate is an amount proposed by Bidders and stated on the Bid Form that will be added to or deducted from Base Bid amount if the Owner decides to accept a corresponding change in either scope of work or in products, materials, equipment, systems or installation methods described in Contract Documents.
- B. Coordination: Coordinate related work and modify or adjust adjacent work as required to ensure that work affected by each accepted alternate is complete and fully integrated into the project.
- C. Notification: Immediately following award of Contract, prepare and distribute to each party involved, notification of the status of each alternate. Indicate whether alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to alternates, if any.
- D. Schedule: A "Schedule of Alternates" is included at the end of this section. Specification sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the work described under each alternate.
 - 1. Include as part of each alternate, miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No.A1: Larson Middle School - Quote add in price to: Remove and replace wall, doors and frames as indicated in drawings A0.1B and A1.1B Alt and specifications
- B. Alternate No. A2: Larson Middle School - Quote add in price to: Remove and replace doors B100A and B101A as indicated in drawings and specifications

****END OF SECTION****

SCHEDULE OF REQUIRED SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements and schedule tabulating submittals required under the individual Trade Sections.
- B. Related Work: The following submittals are described under other Sections of these Specifications:
 - 1. Division 01 Section "Related Documents Submittal Procedures" for shop drawings.
 - 2. Division 01 Section "Project Record Documents" for project record documents.
 - 3. Division 01 Section "Warranties" for warranties and warranty services.

1.2 SUBMITTALS

- A. Submittals schedule is for reference only and is not necessarily complete. Specific requirements are included in the respective Trade Sections.
- B. Description of submittals and definitions of terms are included under other Sections of Division 01.
- C. Submittal of Materials for Approval:
 - 1. See Division 01 "Product Requirements" for requirements for materials submittals.
 - 2. All materials requiring Manufacturer Services or Warranty shall be submitted in the form specified under "Warranties".
 - 3. Standard materials may be submitted in tabular form. Where necessary to clarify proposed use, submit as a Shop Drawing a schedule of applications or a drawing showing proposed locations.

1.3 SCHEDULE

- A. The Contractor shall prepare a schedule relating and conforming to the Approved Construction Schedule. Said Schedule shall recognize and allow for lead-time, including lead-time required by Subcontractors and Manufacturers, and time required for Architect's review in compliance with the Contract Documents for all submittals.
- B. This Schedule shall be submitted to the Owner and the Architect for approval prior to the second Request for Payment.
- C. Exact procedures and time schedules for submittals will be determined at the time Job Progress Schedule is established. Time schedule for submittals shall be periodically revised and adjusted to coordinate with job progress.

1.4 EQUIPMENT ROOM LAYOUT DRAWINGS

- A. Each Contractor shall prepare and submit equipment room layout drawings, as called for under "Shop Drawings and Samples," for all equipment furnished under its Contract.
- B. Scale (Minimum): 1/4 inch equals 1 foot.

1.5 CERTIFICATE OF COMPLIANCE

- A. Each certificate required for demonstrating proof of compliance of materials with specification requirements, including mill certificates, shall be executed in quadruplicate. It shall be the Contractor's responsibility to review all certificates, before submittal, to ensure compliance with the Contract Documents.
- B. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name and address of the Contractor, the project name and location and the quantity and date or dates of shipment or delivery to which the certificate applies.
- C. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if after tests are performed on selected samples, the material is found not to meet the specific requirements.

1.6 SPARE PARTS DATA

- A. The Contractor shall furnish spare parts data for each different item of equipment furnished if and as called for in the Trade Sections.

1.7 SAMPLES

- A. After the award of the Contract, the Contractor shall furnish, for approval, samples required by the Specifications. The Contractor shall prepay all shipping charges on samples.
- B. Materials or equipment for which samples are required shall not be used in the work until approved in writing.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Where required by the Specifications, Operation and Maintenance Manuals shall be provided by the Contractor as specified under "Project Record Documents".
- B. Provide all manuals, parts information and similar data that the Architect may determine to be necessary for proper operation and maintenance.
- C. The manuals shall cover the operation requirements of each item specified to require operational and maintenance manuals, and shall include standard maintenance procedures and recommended schedules for routine service. The manuals shall be submitted to the Architect ten (10) days prior to final tests of mechanical and electrical system.

1.9 TEST PROCEDURES AND TEST RESULTS

- A. Where required by the Technical Specifications test procedures and test results shall be provided by the Contractor in quadruplicate. Test procedures shall cover all items required by the Technical Provisions and as specified under "Laboratory Testing and Inspection."

****END OF SECTION****

ELECTRONIC SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for preparation, submittal, and distribution of Shop Drawings, Samples, Product Data, and similar information required to be furnished by the Contractors.
- B. Related Work: The following items of work are specified under other Sections of these Specifications:
 - 1. Division 01 Section "Electronic Project Record Documents" for electronic project record documents.

1.2 DEFINITIONS

- A. Samples: See General Conditions.
 - 1. Preliminary Samples: Hand made or simulated examples or proposed materials submitted to demonstrate anticipated finished appearance.
 - 2. Product Samples: Representative examples of materials proposed for use.
 - 3. Range Samples: Samples showing extremes of variations in appearance, texture or color and the limits within which the Contractor agrees to hold the materials used in the work.
 - 4. Sample Installation: Trial run or initial example provided for review and acceptance by the Architect before continuing with the work.
 - 5. Test Samples: Samples provided for purposed of physical or chemical test analysis. If samples are submitted directly to the Testing Laboratory, submit copy of letter of transmittal.
- B. Shop Drawings: See General Conditions
 - 1. Electronic File: Drawings and other data submitted electronically in PDF format only.
 - 2. Preliminary Shop Drawings: Drawings and other data submitted electronically prior to acceptance of systems and only required to show information necessary for evaluation and coordination with other work.
 - 3. Project Shop Drawings: Drawings and other data illustrating materials and assemblies proposed for the Project.
 - 4. Coordination Drawings: Original electronic drawings prepared by the Trades to investigate conflicts and coordinate locations of each with the work of the other.

- C. Identification: All shop drawings, samples and product data shall be identified by the project title, Construction Manager's name, the Architect's name and the Architect's project number or numbers.

1.3 ELECTRONIC SUBMITTAL PROCEDURES

A. Summary:

1. Shop drawing and product data submittals shall be transmitted to the Construction Manager in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.
2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
3. Physical samples (color samples, color charts, physical material samples, etc.) will be accompanied by an electronic transmittal processed through Submittal Exchange. Refer to Paragraph 1.4E for additional information.

B. Procedures:

1. Submittal Preparation –Subcontractors and Suppliers may use any or all of the following options as directed by the Construction Manager.
 - a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via email.
 - b. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format and submits to the Construction Manager by uploading to Submittal Exchange.
2. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
3. Contractor shall transmit each submittal to Construction Manager using the Submittal Exchange website, www.submittalexchange.com.
4. Construction Manager shall transmit each submittal to the Architect using the Submittal Exchange website, www.submittalexchange.com.
5. Architect / Engineer review comments will be made available on the Submittal Exchange website for downloading. Construction Manager will receive email notice of completed review and send notification to the Contractor.
6. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
7. Submit electronic copies of reviewed submittals at project closeout for record purposes in accordance with Section 017839 "Electronic Project Record Documents"

C. Costs:

1. Cost of data management service (Submittal Exchange) shall be paid for by the Project Owner thru the Construction Manager.
2. At Contractor's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 1-800-714-0024.
3. Internet Service and Equipment Requirements:
 - a. Email address and Internet access at Contractor's main office.
 - b. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

1.4 GENERAL REQUIREMENTS FOR ELECTRONIC SUBMITTALS:

- A. Contractor shall transmit each submittal (shop drawings and product data) to the Construction Manager using the Submittal Exchange website, www.submittalexchange.com. Submittals are to be made in the following form.
 1. Shop drawing: Combined together into one pdf file for each assembly.
 2. Product data: Provide product data in individual pdf file.
- B. File naming shall be in the following format. Specification Section Number; consecutive number of submittal for that section; revision number for that section; school name(s) (where multiple schools are involved only); and description of file being submitted (submittal type).
 1. Example: 079200-01-00_Watt, Wass_Joint Sealants_Product data.pdf.
 2. Example: 123204-07-01_Prefabricated Casework_Shop Drawings.pdf.
- C. Contractor shall fill out the TMP Shop Drawing and Sample Transmittal Form found at the end of this Section and include at the beginning of the file. An electronic version of Transmittal Form is available upon request from the Architect, thru the Construction Manager. Also, an electronic version of this form is part of the upload process in Submittal Exchange.
- D. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work prior to notifying the Construction Manager that the submittal is read for review.
- E. Physical Samples must be submitted through the Construction Manager and must be accompanied by an electronic (PDF) copy of the completed TMP Shop Drawing and Transmittal Form. Electronic Transmittal Form must be submitted to the Construction Manager using the Submittal Exchange website.

1.5 SCHEDULES

- A. Prepare Shop Drawing Submittal Schedule as required.

- B. Recognize and allow for lead-time required for manufacture, fabrication, delivery to the site, and for review.
- C. Arrange schedule in orderly sequence in compliance with Project Schedule.
- D. Request for approval of materials, systems, substitutions, or for deviations from the Contract Documents shall be submitted according to Section 016000 – “Product Requirements” and shall be Preliminary submittal with allowances for time for review prior to submittal of Product Samples or Project Shop Drawings.

1.6 SAMPLES - GENERAL

- A. Samples in general, are required for all materials that form an exposed part of the finished Project. Samples of concealed components are not required unless specifically called for.
- B. Typical Samples shall be taken from production run material and shall be representative examples of proposed quality and finish.
- C. Preliminary Samples shall, as far as possible, anticipate the quality and finish of production run material.
- D. Samples will be retained at the job site for comparison purposes. Samples of manufactured items will be returned to the Contractor for installation in the Work after approval of materials. Use in locations where directed.
- E. All materials in the completed installation shall be equal in every respect to the approved product samples and within the limits defined by the approved range samples.

1.7 SAMPLES SUBMITTALS

- A. Size and quantity, unless otherwise specified: Four (4) each; 8 inches by 12 inches, or 12 inches long, as applicable; not over one inch thick for masonry or cementitious materials.
- B. Preliminary or Range Samples shall be resubmitted as directed until an acceptable Sample or Range is established, at which time Project Samples shall be submitted.
- C. Furnish Samples to other trades where required to match color or finish.
- D. Required Samples are scheduled or are listed in the Trade Sections. Optional Samples will be accepted and reviewed by the Architect.
- E. Review will be for shape and appearance only. Physical and chemical properties shall be established by adequate documentation that shall accompany samples.
- F. In all cases where preliminary approval samples have been submitted, final production run, or in-place installation samples will be required for verification.
- G. Notify Construction Manager and Architect in advance and obtain directions for place and time to ship large, heavy or bulky samples. Ship such samples "Prepaid." If return is requested, they will be returned "Collect."

1.8 SHOP DRAWINGS AND PRODUCT DATA - GENERAL

- A. Shop Drawings shall be prepared by a qualified detailer and shall be complete including erection diagrams and shall show the fabrication and construction of all items required for complete assembly.
- B. Provide pertinent information relating to installation and connection to work of other trades, and coordinate with work of other trades as required for proper placing, anchorage and support of the work. Indicate in detail, the precise location and spacing of all embedded anchor bolts, sleeves and other features required to be placed in the concrete, structural steel or masonry or otherwise required to be built into the structure.
- C. Identify details by reference to the Contract Drawings, other Shop Drawings or other information as required to properly identify and locate the portion of the Work covered.
- D. Indicate on the Drawings and explain by covering letter all proposed deviations from the requirements of the Contract Documents.
- E. Manufacturer's Standard Documents:
 - 1. Drawings and similar documents provide in PDF version from original documents: Modify drawings to delete information which is not applicable to the Project, provide additional information where required and submit electronically.
 - 2. Brochures and other pre-printed data, clearly mark PDF information as follows:
 - a. Identify pertinent material, product, and model.
 - b. Number or otherwise reference each item to applicable Contract Document or other Shop Drawing.
 - c. Show dimensions and clearances required.
 - d. Provide all other information required for Shop Drawings including, where applicable, wiring diagrams and controls.
 - e. Delete all options, or variations from the Contract Documents, except where such items are specifically noted as proposed deviations.
- F. Where proper installation of the work requires that other work be set to special detail, held to tolerance, or dimension be established, so indicate on the Shop Drawings.
- G. Where items must fit spaces previously constructed, take measurements at the site, not from drawings.
- H. Where applicable, indicate mechanical and electrical characteristics of, or required to be provided for, the material shown on the Shop Drawings.
- I. Each shop drawing or coordination drawing shall have a blank area (5 x 8 inches), located adjacent to the title block. The title block shall display the following:
 - 1. Number and title of drawing
 - 2. Date of drawing or revision
 - 3. Name or project building or facility

4. Name of Contractor and (if appropriate) name of Subcontractor submitting drawings.
5. Clear identity of contents and location of the work.
6. Project title and contract number.
7. Initials or party preparing drawings.
8. Signature of party responsible and, where applicable, professional engineers seal.

1.9 SHOP DRAWINGS - TYPES

A. Preliminary Shop Drawings:

1. Preliminary Shop Drawings shall be provided for portions of the Work where interpretations or variations from the Contract Documents are proposed, or otherwise required.

B. Project Shop Drawings:

1. Project Shop Drawings shall show all changes to building details to coordinate with required modifications and indicate approval by other trades for required modifications to their work.
2. Where Shop Drawings are based on the use of a particular material, such material shall be submitted for review independently of the Shop Drawing.
3. When Shop Drawings are submitted in the form of brochures indicate all current variations from the information in effect at time documents were issued for bids.

C. Coordination Drawings: Comply with all requirements of Project Manual

1.10 DELEGATED-DESIGN SUBMITTALS

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Architect thru the Construction Manager.

B. Shop Drawings: Submit shop drawings for each component of work identified, signed and sealed by the qualified professional engineer responsible for their preparation licensed in the State of Michigan.

C. Engineering Analysis: Submit comprehensive engineering analysis for each component of work identified, signed and sealed by the qualified professional engineer responsible for their preparation licensed in the State of Michigan.

1. 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.

- D. Product Data: Submit product data for each product and system specifically assigned to the Contractor to be designed or certified by a design professional, signed and sealed by the responsible design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads and other factors used to certify the product.
- E. Submittals: Shop drawings, engineering analysis, product data and other required submittals will be digitally signed and sealed and submitted electronically. The design professional's seal, license number, and signature shall be clear and legible and shall appear on each shop drawing sheet, each product data coversheet, and engineering analysis coversheet.

1.11 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall obtain, review, stamp with his approval and submit for review all Shop Drawings and Samples required by the Contract Documents. The Contractor shall be required to utilize the "Shop Drawing Transmittal Form attached to this section. Submittal materials for only one (1) specification section trade shall be submitted per each transmittal form. Do not combine submittals for multiple specification sections on one transmittal form. Use a separate transmittal form for each specification section.
- B. By approving and submitting Shop Drawings and Samples, the Contractor thereby represents that he has determined and verified all field measurements and field construction criteria at the site, and all materials, catalog numbers and similar data, or will do so, and that he has checked and coordinated each Shop Drawing and Sample with the requirements of the work and of the Work and of the Contract Documents.
- C. The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Owner's, Construction Manager's, or the Architect's acceptance of Shop Drawings, Product Data or Samples, unless the Contractor has informed the Owner, Construction Manager and the Architect, in writing, of such deviation at the time of submission and the Architect has given written acceptance to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples by the acceptance thereof.
- D. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples to revisions other than those requested on previous submittals.
- E. No portion of the Work requiring submission of Shop Drawings, Product Data or Sample shall be commenced until the submittal has been accepted as provided herein. All such portions of the Work shall be in accordance with accepted submittals.

1.12 ARCHITECT'S REVIEW

- A. The Architect will complete review of Shop Drawings within fifteen (15) working days, and of Samples within twenty-one (21) working days of receipt thereof except that:

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1. Shorter time limits will be negotiated on a basis of need for each specific case for "fast track" or critical path items.
 2. With respect to those areas with special architectural finishes and coordination of various material sources the parties shall agree upon a mutually satisfactory time schedule.
 3. Review time will be considered as starting when Drawings and Samples are substantially correct and so submitted.
 4. Incomplete or incorrect submittals will be returned without review, for proper submission.
- B. Shop Drawings, Samples and Product Data will be reviewed only for conformance with the design concept, compliance with the information given in the Contract Documents, arrangement and appearance. Deviations from the Contract Documents will be noted with comments and required corrections or changes will be noted on the returned submittal.
- C. Delegated Design Submittals will be reviewed only for conformance with the general design concept, compliance with performance and design criteria, and for loads transmitted to the building structure. Engineering analysis and calculations will not be reviewed and will be retained for record only. The Contractor is responsible for the design and performance of the delegated design systems and components. The review of a delegated design submittal shall not relieve the Contractor of the responsibility for proper and safe design.
- D. Contractor will be notified through the data management service when review is completed.
- E. Architect will retain electronic file of Product Data and A-E "mark-ups" or corrections of mark-ups.
- F. The Architect will **not** accept physical copies (hard copies) of shop drawings or product data submittals. Physical submittals will be accepted for Samples only. Physical Samples must be submitted through the Construction Manager and must be accompanied by an electronic (PDF) copy of the completed TMP Shop Drawing and Sample Transmittal Form.
- G. One sample from each set will be returned to the Contractor, one filed at the office of the Architect, one at the office of the Construction Manager or and one at the jobsite. If the Contractor intends that samples such as hardware or fixtures be installed on the project or returned at completion of the Project, he shall indicate at time of submittal, otherwise the Owner, Construction Manager and the Architect assume no responsibility for protection or return of such samples.

1.13 EQUIPMENT ROOM LAYOUT DRAWINGS

- A. The Contractor shall prepare and submit equipment room layout drawings as required by the technical specifications and additionally for areas where equipment proposed for use could present interface or space difficulties. Such drawings shall be prepared in the same manner as coordination drawings.

1.14 MATERIALS, EQUIPMENT AND FIXTURE LISTS

- A. Where required by the Technical Provisions, lists of materials, equipment and fixtures shall be submitted by the Contractor. The lists shall be supported by sufficient descriptive material, such as catalogs, cuts, diagrams, and other data published by the manufacturer, as well as evidence of compliance with safety and performance standards, to demonstrate conformance to the specification requirements; catalog numbers alone will not be acceptable.
- B. The data shall include the name and address of the nearest service and maintenance organization that regularly stocks repair parts. No consideration will be given to partial lists submitted from time to time.
- C. Materials, equipment and fixtures will not be approved for use at capacity ratings in excess of manufacturer's published data.
- D. Approval of materials and equipment will be tentative subject to submission of complete shop drawings indicating compliance with the Contract Documents.

TMP SHOP DRAWING AND SAMPLE TRANSMITTAL FORM

CONTRACTOR/CONST. MANAGER:	PROJECT TITLE AND LOCATION:	DATE SUBMITTED: _____	NEW _____	SUB. NO. _____
<div style="border-bottom: 1px solid black; margin-bottom: 2px;"></div> <div style="border-bottom: 1px solid black; margin-bottom: 2px;"></div> <div style="border-bottom: 1px solid black;"></div>	<div style="border-bottom: 1px solid black; margin-bottom: 2px;"></div> <div style="border-bottom: 1px solid black; margin-bottom: 2px;"></div> <div style="border-bottom: 1px solid black;"></div>	CHECKER: _____	RESUB. _____	RESUB. NO. _____
		TMP PROJECT NO. _____		

SPEC SECTION NO.	NO. PRINT	NO. SEPI	NO. CAT.	NO. SAMPLES	SUBCONTRACTOR/MFR.	ITEM DESCRIPTION	*ACTION CODE	DATE CHECKED	DATE RETURNED	NO. COPIES

The undersigned certifies that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract documents except as otherwise noted. NOTE: Approval of items submitted does not relieve contractor from complying with all requirements of the contract documents.		* ACTION DEFINITION R = REVIEWED – NO EXCEPTIONS NOTED RN = REVIEWED WITH CORRECTIONS NOTED RR = REVISE AND SEND RECORD COPY X = NOT APPROVED – RESUBMIT NA = NO ACTION REQ'D
CONTRACTOR'S COMMENTS: ARCHITECT'S COMMENTS:	<div style="border-bottom: 1px solid black; margin-bottom: 10px;"></div> CONTRACTOR'S NAME <div style="border-bottom: 1px solid black; margin-bottom: 10px;"></div> SIGNATURE cc: Owner Consultant	

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions.
- B. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Architect," "requested by the Architect," and similar phrases.
- D. Approve: The term "approved," where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in General and Supplementary Conditions.
- E. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
- G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
- H. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
- I. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term "experienced" when used with the term "Installer" means having a minimum of 5 previous Projects similar in size and scope to this Project, being familiar with the precautions required, and having complied with requirements of the authority having jurisdiction.
 - 2. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

3. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.
 - a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.
- J. Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.
- K. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's MASTERFORMAT 2004 Edition (MF04) numbering system.
 1. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the full context of the Contract Documents so indicates.
 2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
 - a. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.
 2. Although copies of standards needed for enforcement of requirements may be included as part of required submittals, the Architect reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.
- F. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations as referenced in Contract Documents are defined to mean the associated names. Names and addresses are subject to change and are believed to be but are not assured to be accurate and up to date as of date of Contract Documents.

AA	Aluminum Association 900 19th St., NW, Suite 300 Washington, DC 20006 www.aluminum.org	(202)862-5100
AABC	Associated Air Balance Council 1518 K St., NW, Suite 503 Washington, DC 20005 www.aabchq.com	(202)737-0202
AAMA	American Architectural Manufacturers Association 1827 Walden Office Sq., Suite 104 Schaumburg, IL 60173-4268 www.aamanet.org	(847)303-5664
AAN	American Association of Nurserymen (See ANLA)	
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol St., NW, Suite 249 Washington, DC 20001 www.aashto.org	(202)624-5800

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REFERENCES

AATCC	American Association of Textile Chemists and Colorists P.O. Box 12215 One Davis Dr. Research Triangle Park, NC 27709-2215 www.aatcc.org	(919)549-8141
ABMA	American Bearing Manufacturers Association (Formerly: Anti-Friction Bearing Manufacturers Association) 1200 19th St., NW, Suite 300 Washington, DC 20036-2401 www.abma-dc.org	(202)429-5155
ABMA	American Boiler Manufacturers Association 950 North Glebe Rd., Suite 160 Arlington, VA 22203-1824 www.abma.com	(703)522-7350
ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333-9094 www.aci-int.org	(248)848-3700
ACIL	ACIL: The Association of Independent Scientific, Engineering, and Testing Firms 1629 K St., NW, Suite 400 Washington, DC 20006 www.acil.org	(202)887-5872
ACPA	American Concrete Pipe Association 222 West Las Colinas Blvd., Suite 641 Irving, TX 75039-5423 www.concrete-pipe.org	972) 506-7216
ADC	Air Diffusion Council 104 South Michigan Ave., Suite 1500 Chicago, IL 60603	(312) 201-0101
AEIC	Association of Edison Illuminating Companies 600 N. 18th St. P.O. Box 2641 Birmingham, AL 35291-0992 www.aeic.org	(205) 250-2530
AFBMA	Anti-Friction Bearing Manufacturers Association (See ABMA)	
AFPA	American Forest and Paper Association (Formerly: National Forest Products Association) 1111 19th St., NW, Suite 800 Washington, DC 20036 www.afandpa.org	(800) 878-8878 (202) 463-2700

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REFERENCES

AGA	American Gas Association 1515 Wilson Blvd. Arlington, VA 22209 www.aga.com	(703) 841-8400
AHA	American Hardboard Association 1210 W. Northwest Hwy Palatine, IL 60067-1897	(847) 934-8800
AHAM	Association of Home Appliance Manufacturers 20 N. Wacker Dr., Suite 1231 Chicago, IL 60606 www.aham.org	(312) 984-5800
AI	Asphalt Institute P.O. Box 14052 Lexington, KY 40512-4052 www.asphaltinstitute.org	(606) 288-4960
AIA	The American Institute of Architects 1735 New York Ave., NW Washington, DC 20006-5292 www.aia.org	(202) 626-7300
AIA	American Insurance Association 1130 Connecticut Ave., NW, Suite 1000 Washington, DC 20036	(202) 828-7100
AIHA	American Industrial Hygiene Association 2700 Prosperity Ave., Suite 250 Fairfax, VA 22031 www.aiha.org	(703) 849-8888
AISC	American Institute of Steel Construction One East Wacker Dr., Suite 3100 Chicago, IL 60601-2001 www.aisc.web.com	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute 1101 17th St., NW, Suite 1300 Washington, DC 20036-4700 www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction 7012 S. Revere Pkwy, Suite 140 Englewood, CO 80112 www.aitc-glulam.org	(303) 792-9559
ALA	American Laminators Association (See LMA)	

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REFERENCES

ALCA	Associated Landscape Contractors of America 150 Elden St., Suite 270 Herndon, VA 20170-4831 www.alca.org	(800) 395-2522 (703) 736-9666
ALI	Associated Laboratories, Inc. P.O. Box 152837 Dallas, TX 75315 www.assoc-labs.com	(214) 565-0593
ALSC	American Lumber Standards Committee P.O. Box 210 Germantown, MD 20875	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. 30 W. University Dr. Arlington Heights, IL 60004-1893 www.amca.org	(847) 394-0150
ANLA	American Nursery and Landscape Association (Formerly: American Association of Nurserymen) 1250 Eye St., NW, Suite 500 Washington, DC 20005 www.anla.org	(202) 789-2900
ANSI	American National Standards Institute 11 West 42nd St., 13th Floor New York, NY 10036-8002 www.ansi.org	(888) 267-4783 (212) 642-4900
AOAC	AOAC International 481 N. Frederick Ave., Suite 500 Gaithersburg, MD 20877 www.aoac.org	(301) 924-7077
AOSA	Association of Official Seed Analysts P.O. Box 81152 Lincoln, NE 68501-1152 www.zianet.com/AOSA	(402) 476-3852
APA	APA-The Engineered Wood Association (Formerly: American Plywood Association) P.O. Box 11700 Tacoma, WA 98411-0700 www.apawood.org	(253) 565-6600
APA	Architectural Precast Association P.O. Box 08669 Fort Myers, FL 33908-0669 www.archprecast.org	(941) 454-6989

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REFERENCES

API	American Petroleum Institute 1220 L St., NW, Suite 900 Washington, DC 20005-8029 www.api.org	(202) 682-8000
ARI	Air-Conditioning and Refrigeration Institute 4301 Fairfax Dr., Suite 425 Arlington, VA 22203 www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association Center Park 4041 Powder Mill Rd., Suite 404 Calverton, MD 20705 www.asphaltroofing.org	(301) 348-2002
ASA	Acoustical Society of America 500 Sunnyside Blvd. Woodbury, NY 11797 //asa.aip.org	(516) 576-2360
ASC	Adhesive and Sealant Council 1627 K St., NW, Suite 1000 Washington, DC 20006-1707 www.ascouncil.org	(202) 452-1500
ASCA	Architectural Spray Coaters Association 895 Doncaster Dr. West Deptford, NJ 08066	(609) 848-6120
ASCE	American Society of Civil Engineers World Headquarters 1801 Alexander Graham Bell Dr. Reston, VA 20191-4400 www.asce.org	(800) 548-2723 (703) 295-6000
ASHES	American Society for Healthcare Environmental Services Division of the American Hospital Association One North Franklin, Suite 2700 Chicago, IL 60606	(312) 422-3860
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329-2305 www.ashrae.org	(800) 527-4723 (404) 636-8400
ASLA	American Society of Landscape Architects 636 Eye St., NW Washington, DC 20001-3736 www.asla.org	(202) 898-2444

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REFERENCES

ASME	American Society of Mechanical Engineers 345 East 47th St. New York, NY 10017-2392 www.asme.org	(800) 843-2763 (212) 705-7722
ASPA	American Sod Producers Association (See TPI)	
ASPE	American Society of Plumbing Engineers 3617 Thousand Oaks Blvd., Suite 210 Westlake Village, CA 91362-3649	(805) 495-7120
ASQ	American Society for Quality 611 East Wisconsin Ave. Milwaukee, WI 53201-3005 www.asq.org	(800) 248-1946 (414) 272-8575
ASSE	American Society of Sanitary Engineering 28901 Clemens Rd. Westlake, OH 44145 www.asse-plumbing.org	(440) 835-3040
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohocken, PA 19428-2959 www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions (Formerly: Exchange Carriers Standards Association) 1200 G St., NW, Suite 500 Washington, DC 20005 www.atis.org	(202) 628-6380
AWCI	Association of the Wall and Ceiling Industries--International 803 West Broad St., Suite 600 Falls Church, VA 22046 www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (See WCMA)	
AWI	Architectural Woodwork Institute 1952 Isaac Newton Sq. West Reston, VA 20190 www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association P.O. Box 5690 Granbury, TX 76049 www.awpa.com	(817) 326-6300

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REFERENCES

AWPB	American Wood Preservers' Bureau (This organization is now defunct.)	
AWS	American Welding Society 550 NW LeJeune Rd. Miami, FL 33126 www.amweld.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association 6666 W. Quincy Ave. Denver, CO 80235 www.awwa.org	(800) 926-7337 (303) 794-7711
BAC	Brick Association of the Carolinas (Formerly: Brick Association of North Carolina) P.O. Box 13290 Greensboro, NC 27415-3290 www.gobrick.com	(800) 622-7425 (336) 273-5566
BHMA	Builders Hardware Manufacturers Association 355 Lexington Ave., 17th Floor New York, NY 10017-6603	(212) 661-4261
BIA	Brick Industry Association 11490 Commerce Park Dr. Reston, VA 22091-1525 www.bia.org	(703) 620-0010
BIFMA	The Business and Institutional Furniture Manufacturer's Association International 2680 Horizon Dr., SE, Suite A1 Grand Rapids, MI 49546-7500 www.bifma.com	(616) 285-3963
CAGI	Compressed Air and Gas Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/cagi	(216) 241-7333
CAUS	Color Association of the United States 409 W. 44th St. New York, NY 10036-4402	(212) 582-6884
CBMA	Certified Ballast Manufacturers Association 355 Lexington Ave., 17th Floor New York, NY 10017 www.certbal.org	(212) 661-4261
CCC	Carpet Cushion Council P.O. Box 546 Riverside, CT 06878-0546	(203) 637-1312

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REFERENCES

CDA	Copper Development Association Inc. 260 Madison Ave., 16th Floor New York, NY 10016-2401 www.copper.org	(800) 232-3282 (212) 251-7200
CFFA	Chemical Fabrics & Film Association, Inc. c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/cffa	(216) 241-7333
CGA	Compressed Gas Association 1725 Jefferson Davis Hwy, Suite 1004 Arlington, VA 22202-4102 www.cganet.com	(703) 412-0900
CGSB	Canadian General Standards Board Place du Portage Phase III, 6B1 11 Laurier St. Hull, Quebec K1A 0S5 CANADA www.pwgsc.gc.ca/cgsb Mailing Address: Canadian General Standards Board Sales Centre Ottawa K1A 1G6 CANADA	(819) 956-3500 (819) 956-0425
CISCA	Ceilings and Interior Systems Construction Association 1500 Lincoln Hwy, Suite 202 St. Charles, IL 60174 www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute 5959 Shallowford Rd., Suite 419 Chattanooga, TN 37421 www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute 9891 Broken Land Pkwy, Suite 300 Columbia, MD 21046 www.baileadership.com	(301) 596-2584
CPA	Composite Panel Association (Formerly: National Particleboard Association) 18928 Premiere Ct. Gaithersburg, MD 20879-1569 www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association 3621 Secor Rd., Suite 320 Toledo, OH 436046 www.cppa-info.org	(800) 510-2772 (419) 241-2221

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REFERENCES

CRI	Carpet and Rug Institute 310 S. Holiday Ave. Dalton, GA 30722-2048 www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Rd. Schaumburg, IL 60173-4758 www.crsi.org	(847) 517-1200
CSSB	Cedar Shake and Shingle Bureau 515 116th Ave., NE, Suite 275 Bellevue, WA 98004-5294 www.cedarbureau.org	(206) 453-1323
CTI	Ceramic Tile Institute of America 12061 West Jefferson Blvd. Culver City, CA 90230-6219	(310) 574-7800
CTI	Cooling Tower Institute P.O. Box 73383 Houston, TX 77273 www.cti.org	(281) 583-4087
DASMA	Door and Access Systems Manufacturers Association, International (Formerly: National Association of Garage Door Manufacturers) c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/dasma	(216) 241-7333
DHI	Door and Hardware Institute (Formerly: National Builders Hardware Association) 14170 Newbrook Dr. Chantilly, VA 20151-2223 www.dhi.org	(703) 222-2010
DIPRA	Ductile Iron Pipe Research Association 245 Riverchase Pkwy East, Suite O Birmingham, AL 35244 www.dipra.org	(205) 402-8702
DLPA	Decorative Laminate Products Association (Dissolved in 1995 - Now part of KCMA.)	
ECSA	Exchange Carriers Standards Association (See ATIS)	
EIA	Electronic Industries Association 2500 Wilson Blvd. Arlington, VA 22201 www.eia.org	(703) 907-7500

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REFERENCES

EIMA	EIFS Industry Members Association 3000 Corporate Center Dr., Suite 270 Morrow, GA 30260-4116 www.eifsfacts.com	(800) 294-3462 (770) 968-7945
EJMA	Expansion Joint Manufacturers Association 25 N. Broadway Tarrytown, NY 10591-3201 www.ejma.org	(914) 332-0040
ETL	ETL Testing Laboratories, Inc. (Now part of ITS)	
FCI	Fluid Controls Institute c/o Thomas Associates, Inc 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/fci	(216) 241-7333
FCICA	Floor Covering Installation Contractors Association P.O. Box 948 Dalton, GA 30722-0948	(706) 226-5488
FGMA	Flat Glass Marketing Association (See GANA)	
FM	Factory Mutual System 1151 Boston-Providence Tnpk. P.O. Box 9102 Norwood, MA 02062-9102 www.factorymutual.com	(781) 762-4300
GA	Gypsum Association 810 First St., NE, Suite 510 Washington, DC 20002 www.usg.com	(202) 289-5440
GANA	Glass Association of North America (Formerly: Flat Glass Marketing Association) 2945 Southwest Wanamaker Dr., Suite A Topeka, KS 66614 www.glasswebsite.com/gana	(913) 266-7013
GRI	Geosynthetic Research Institute 475 Kedron Ave. Folsom, PA 19033 www.drexel.edu/gri	(610) 522-8440
HEI	Heat Exchange Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/hei	(216) 241-7333

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REFERENCES

HI	Hydraulic Institute 9 Sylvan Way Parsippany, NJ 07054-3802	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute Division of Gas Appliance Manufacturers Association P.O. Box 218 35 Russo Pl. Berkeley Heights, NJ 07922 www.gamanet.org	(908) 464-8200
HMA	Hardwood Manufacturers Association (Formerly: Southern Hardwood Lumber Manufacturers Association) 400 Penn Center Blvd., Suite 530 Pittsburgh, PA 15235-5605 www.hardwood.org	(412) 829-0770
HPVA	Hardwood Plywood and Veneer Association 1825 Michael Farraday Dr. P.O. Box 2789 Reston, VA 22195-0789 www.hpva.org	(703) 435-2900
IAS	International Approval Services Division of Canadian Standards Association 8501 East Pleasant Valley Rd. Cleveland, OH 44131 www.iasapprovals.org	(216) 524-4990
IBD	Institute of Business Designers (Now part of IIDA)	
ICC	International Code Council 5203 Leesburg Pike #708 Falls Church, VA 22041 www.intlcode.org	(703) 931-4533
ICEA	Insulated Cable Engineers Association P.O. Box 440 South Yarmouth, MA 02664 www.icea.net	(508) 394-4424
IEC	International Electrotechnical Commission (Available from ANSI) 11 West 42nd St., 13th Floor New York, NY 10036-8002 www.ansi.org	(888) 267-4783 (212) 642-4900
IEEE	Institute of Electrical and Electronics Engineers 345 E. 47th St. New York, NY 10017-2394 www.ieee.org	(800) 678-4333 (212) 705-7900

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REFERENCES

IESNA	Illuminating Engineering Society of North America 120 Wall St., 17th Floor New York, NY 10005-4001 www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council P.O. Box 9 Henderson Harbor, NY 13651	(315) 938-7444
IIDA	International Interior Design Association 341 Merchandise Mart Chicago, IL 60654-1104 www.iida.com	(800) 888-4432 (312) 467-1950
ILI	Indiana Limestone Institute of America Stone City Bank Building, Suite 400 Bedford, IN 47421 www.iliai.com	(812) 275-4426
IMSA	International Municipal Signal Association P.O. Box 539 165 E. Union St. Newark, NY 14513 www.imsasafety.org	(800) 723-4672 (315) 331-2182
INCE	Institute of Noise Control Engineering P.O. Box 3206, Arlington Branch Poughkeepsie, NY 12603 www.ince.org	(914) 462-4006
IRI	HSB Industrial Risk Insurers P.O. Box 5010 85 Woodland St. Hartford, CT 06102-5010 www.industrialrisk.com	(800) 520-7300 (860) 520-7300
ISA	ISA - International Society for Measurement and Control P.O. Box 12277 67 Alexander Dr. Research Triangle Park, NC 27709 www.isa.org	(919) 549-8411
ISEA	Industrial Safety Equipment Association 1901 N. Moore St., Suite 808 Arlington, VA 22209 www.safetycentral.org/isea	(703) 525-1695
ISS	Iron and Steel Society 410 Commonwealth Dr. Warrendale, PA 15086-7512 www.issource.org	(412) 776-1535

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REFERENCES

ITS	Intertek Testing Services (Formerly: Inchcape Testing Services) P.O. Box 2040 3933 US Route 11 Cortland, NY 13045-7902 www.itsglobal.com	(800) 345-3851 (607) 753-6711
KCMA	Kitchen Cabinet Manufacturers Association (Formerly: National Kitchen Cabinet Association) 1899 Preston White Dr. Reston, VA 22191 www.kema.org	(703) 264-1690
LGSi	Light Gage Structural Institute P.O. Box 560746 The Colony, TX 75056	(972) 625-4560
LIA	Lead Industries Association, Inc. 295 Madison Ave., Suite 808 New York, NY 10017 www.leadinfo.com	(800) 422-5323 (212) 578-4750
LMA	Laminating Materials Association (Formerly: American Laminators Association) 116 Lawrence St. Hillsdale, NJ 07642-2730 www.lma.org	(201) 664-2700
LPI	Lightning Protection Institute 3335 N. Arlington Heights Rd., Suite E Arlington Heights, IL 60004-7700 www.lightning.org	(800) 488-6864 (847) 577-7200
MBMA	Metal Building Manufacturers Association c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/mbma	(216) 241-7333
MCAA	Mechanical Contractors Association of America 1385 Piccard Dr. Rockville, MD 20850-4329 www.mcaa.org	(301) 869-5800
MFMA	Maple Flooring Manufacturers Association (Formerly: Wood and Synthetic Flooring Institute) 60 Revere Dr., Suite 500 Northbrook, IL 60062 www.maplefloor.com	(847) 480-9138
MFMA	Metal Framing Manufacturers Association 401 N. Michigan Ave. Chicago, IL 60611	(312) 644-6610

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REFERENCES

MHIA	Material Handling Industry Association 8720 Red Oak Blvd., Suite 201 Charlotte, NC 28217-3957 www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America 30 Eden Alley, Suite 301 Columbus, OH 43215 www.marble-institute.com	(614) 228-6194
MIA	Masonry Institute of America 2550 Beverly Blvd. Los Angeles, CA 90057 www.masonryinstitute.org	(213) 388-0472
ML/SFA	Metal Lath/Steel Framing Association 8 South Michigan Ave., Suite 1000 Chicago, IL 60603	(312) 456-5590
MRCA	Midwest Roofing Contractors Association 4840 W. 15th St., Suite 1000 Lawrence, KS 66049 www.mrca.org	(913) 843-4888
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry 127 Park St., NE Vienna, VA 22180-4602 www.mss-hq.com	(703) 281-6613
NAA	National Arborist Association P.O. Box 1094 Amherst, NH 03031-1094 www.natlarb.com	(800) 733-2622 (603) 673-3311
NAAMM	National Association of Architectural Metal Manufacturers 8 South Michigan Ave., Suite 1000 Chicago, IL 60603 www.gss.net/naamm	(312) 322-0405
NAAMM	North American Association of Mirror Manufacturers (See GANA) 2945 Southwest Wanamaker Dr., Suite A Topeka, KS 66614 www.glasswebsite.com/naamm	(913) 266-7013
NACE	NACE International (Formerly: National Association of Corrosion Engineers) P.O. Box 218340 Houston, TX 77218-8340	(281) 492-0535 (281) 492-8254
NAGDM	National Association of Garage Door Manufacturers (See DASMA)	

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REFERENCES

NAIMA	North American Insulation Manufacturers Association (Formerly: Thermal Insulation Manufacturers Association) 44 Canal Center Plaza, Suite 310 Alexandria, VA 22314 www.naima.org	(703) 684-0084
NAMI	National Accreditation & Management Institute, Inc. P.O. Box 366 207 S. Washington St. Berkeley Springs, WV 25411	(304) 258-5100
NAPA	National Asphalt Pavement Association NAPA Building 5100 Forbes Blvd. Lanham, MD 20706-4413 www.hotmix.org	(888) 468-6499 (301) 731-4748
NBHA	National Builders Hardware Association (See DHI)	
NBGQA	National Building Granite Quarries Association, Inc. 1220 L. St., NW, Suite 100-167 Washington, DC 20005	(800) 557-2848
NCAC	National Council of Acoustical Consultants 66 Morris Ave., Suite 1A Springfield, NJ 07081 www.ncac.com	(973) 564-5859
NCCA	National Coil Coaters Association 401 N. Michigan Ave. Chicago, IL 60611 www.coilcoaters.org	(312) 321-6894
NCMA	National Concrete Masonry Association 2302 Horse Pen Rd. Herndon, VA 20171-3499 www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute P.O. Box 759 253-80 Center St. Lake Geneva, WI 53147 www.ncpi.org	(414) 248-9094
NCRPM	National Council on Radiation Protection and Measurements 7910 Woodmont Ave., Suite 800 Bethesda, MD 20814-3095 www.ncrp.com	(800) 229-2652 (301) 657-2652

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REFERENCES

NCSPA	National Corrugated Steel Pipe Association 1255 23rd St., NW, Suite 850 Washington, DC 20037 www.ncspa.org	(202) 452-1700
NEBB	Natural Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877-4121 www.mcaa.org/nebb.htm www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814-3299 www.necanet.org	(301) 657-3110
NEI	National Elevator Industry 185 Bridge Plaza North, Suite 310 Fort Lee, NJ 07024	(201) 944-3211
NELMA	Northeastern Lumber Manufacturers Association 272 Tuttle Rd. P.O. Box 87A Cumberland Center, ME 04021 www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association 1300 N 17th St., Suite 1847 Rosslyn, VA 22209 www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association P.O. Box 687 106 Stone St. Morrison, CO 80465-1526 www.electricnet.com/neta	(303) 697-8441
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	(800) 344-3555 (617) 770-3000
NFPA	National Forest Products Association (See AFPA)	
NFRC	National Fenestration Rating Council Incorporated 1300 Spring St., Suite 500 Silver Spring, MD 20910 www.nfrc.org	(301) 589-6372

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REFERENCES

NGA	National Glass Association 8200 Greensboro Drive, 3rd Floor McLean, VA 22102-3881	(703) 442-4890
NHLA	National Hardwood Lumber Association P.O. Box 34518 Memphis, TN 38184-0518 www.natlhardwood.org	(901) 377-1818
NIA	National Insulation Association (Formerly: National Insulation and Abatement Contractors Association) 99 Canal Center Plaza, Suite 222 Alexandria, VA 22314 www.insulation.org	(703) 683-6422
NIAC	National Insulation and Abatement Contractors Association (See NIA)	
NKCA	National Kitchen Cabinet Association (See KCMA)	
NLGA	National Lumber Grades Authority #406-First Capital Pl. 960 Quayside Dr. New Westminster, BC V3M 6G2 CANADA	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association P.O. Box 3009 Memphis, TN 38173-0009 www.nofma.org	(901) 526-5016
NPA	National Parking Association 1112 16th Street, NW, Suite 300 Washington, DC 20036	(202) 296-4336 (800) 647-7275
NPCA	National Paint and Coatings Association 1500 Rhode Island Ave., NW Washington, DC 20005-5597 www.paint.org	(202) 462-6272
NRCA	National Roofing Contractors Association O'Hare International Center 10255 W. Higgins Rd., Suite 600 Rosemont, IL 60018-5607 www.roofonline.org	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association 900 Spring St. Silver Spring, MD 20910 www.nrmca.org	(301) 587-1400

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REFERENCES

NSA	National Stone Association 1415 Elliot Pl., NW Washington, DC 20007 www.aggregates.org	(800) 342-1415 (202) 342-1100
NSF	NSF International (Formerly: National Sanitation Foundation) 3475 Plymouth Rd. Ann Arbor, MI 48105 www.nsf.org	(734) 769-8010
NSSEA	National School Supply and Equipment Association 8300 Colesville Rd., Suite 250 Silver Spring, MD 20910 www.nssea.org	(800) 395-5550 (301) 495-0240
NTMA	National Terrazzo and Mosaic Association 110 E. Market St., Suite 200-A Leesburg, VA 20176-3122 www.ntma.com	(800) 323-9736 (703) 779-1022
NUSIG	National Uniform Seismic Installation Guidelines P.O. Box 0933 Alamo, CA 94507	(925) 555-6331
NWMA	National Woodwork Manufacturers Association (See NWWDA)	
NWWDA	National Wood Window and Door Association (Formerly: National Woodwork Manufacturers Association) 1400 E. Touhy Ave. Des Plaines, IL 60018 www.nwwda.org	(800) 223-2301 (847) 299-5200
PATMI	Powder Actuated Tool Manufacturers' Institute 1603 Boonslick Rd. St. Charles, MO 63301-2244	(314) 947-6610
PCA	Portland Cement Association 5420 Old Orchard Rd. Skokie, IL 60077-1083 www.portcement.org	(847) 966-6200
PCI	Precast/Prestressed Concrete Institute 175 W. Jackson Blvd. Chicago, IL 60604 www.pci.org	(312) 786-0300
PDCA	Painting and Decorating Contractors of America 3913 Old Lee Hwy, Suite 33-B Fairfax, VA 22030 www.pdca.com	(800) 332-7322 (703) 359-0826

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REFERENCES

PDI	Plumbing and Drainage Institute 45 Bristol Dr., Suite 101 South Easton, MA 02375 //pdi-online.org	(800) 589-8956 (508) 230-3516
PEI	Porcelain Enamel Institute 4004 Hillsboro Pike, Suite 224-B Nashville, TN 37215 www.porcelainenamel.com	(615) 385-5357
PGI	PVC Geomembrane Institute/Technology Program University of Illinois-Urbana Champaign 205 N. Mathews Ave. 2215 Newmark Civil Engineering Lab Urbana, IL 61801 //pgi-tp.ce.vivc.edu	(217) 333-3929
PIMA	Photographic and Imaging Manufacturers Association 550 Mamaroneck Ave., Suite 307 Harrison, NY 10528 www.pima.net	(914) 698-7603
PPFA	Plastic Pipe and Fittings Association 800 Roosevelt Rd., Building C, Suite 20 Glen Ellyn, IL 60137-5833	(888) 314-6774 (630) 858-6540
PPI	Plastics Pipe Institute (The Society of the Plastics Industry, Inc.) 1801 K St., NW, Suite 600K Washington, DC 20006 www.plasticpipe.org	(202) 974-5306
RCMA	Roof Coatings Manufacturers Association Center Park 4041 Powder Mill Rd., Suite 404 Calverton, MD 20705 www.roofcoatings.org	(301) 348-2003
RCSC	Research Council on Structural Connections Sargent & Lundy 55 E. Monroe St. Chicago, IL 60603	(312) 269-2424
RFCI	Resilient Floor Covering Institute 966 Hungerford Dr., Suite 12-B Rockville, MD 20850-1714	(301) 340-8580
RMA	Rubber Manufacturers Association 1400 K St., NW, Suite 900 Washington, DC 20005 www.rma.org	(800) 220-7620 (202) 682-4800

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REFERENCES

SAE	SAE International 400 Commonwealth Dr. Warrendale, PA 15096-0001 For publications: Call (724) 776-4970 www.sae.org	(724) 776-4841
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021 www.sdi.org	(847) 462-1930
SDI	Steel Door Institute 30200 Detroit Rd. Cleveland, OH 44145-1967 www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association 7 Wildbird Lane Hilton Head Island, SC 29926 www.sefalabfurn.com	(843) 689-6878
SEGD	Society for Environmental Graphic Design 401 F St., NW, Suite 333 Washington, DC 20001-2728	(202) 638-5555
SGCC	Safety Glazing Certification Council P.O. Box 9 Henderson Harbor, NY 13651	(315) 938-7444
SHLMA	Southern Hardwood Lumber Manufacturers Association (See HMA)	
SIGMA	Sealed Insulating Glass Manufacturers Association 401 N. Michigan Ave. Chicago, IL 60611-4267 www.sigmaonline.org/sigma	(312) 644-6610 x3279
SJI	Steel Joist Institute 3127 10th Ave., North Ext. Myrtle Beach, SC 29577-6760	(803) 626-1995
SMA	Screen Manufacturers Association 2850 S. Ocean Blvd., Suite 114 Palm Beach, FL 33480-5535	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Dr. P.O. Box 221230 Chantilly, VA 20151-1209 www.smacna.org	(703) 803-2980

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REFERENCES

SPI	The Society of the Plastics Industry, Inc. Spray Polyurethane Division 1801 K St., NW, Suite 600K Washington, DC 20006 www.socplas.org	(800) 951-2001 (202) 974-5200
SPIB	Southern Pine Inspection Bureau 4709 Scenic Hwy Pensacola, FL 32504-9094 www.spib.org	(850) 434-2611
SPRI	SPRI (Formerly: Single Ply Roofing Institute) 200 Reservoir St., Suite 309A Needham, MA 02494-3034 www.spri.org	(781) 444-0242
SSINA	Specialty Steel Industry of North America c/o Collier, Shannon Rill & Scott 3050 K St., NW, Suite 400 Washington, DC 20007 www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings 40 24th St., 6th Floor Pittsburgh, PA 15222-4656 www.sspc.org	(800) 837-8303 (412) 281-2331
SSPMA	Sump and Sewage Pump Manufacturers Association P.O. Box 647 Northbrook, IL 60065-0647	(847) 559-9233
STI	Steel Tank Institute 570 Oakwood Rd. Lake Zurich, IL 60047-1559 www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/swi	(216) 241-7333
SWPA	Submersible Wastewater Pump Association 1806 Johns Dr. Glenview, IL 60025-1657	(847) 729-7972
SWRI	Sealant, Waterproofing and Restoration Institute 2841 Main St. Kansas City, MO 64108 www.swrionline.org	(816) 472-7974

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REFERENCES

TCA	Tile Council of America P.O. Box 1787 Clemson, SC 29633 www.tileusa.com	(864) 646-8453
TIMA	Thermal Insulation Manufacturers Association (See NAIMA)	
TPI	Truss Plate Institute 583 D'Onofrio Dr., Suite 200 Madison, WI 53719	(608) 833-5900
TPI	Turfgrass Producers International (Formerly: American Sod Producers Association) 1855-A Hicks Rd. Rolling Meadows, IL 60008 www.turfgrassod.org	(800) 405-8873 (847) 705-9898
UFAC	Upholstered Furniture Action Council P.O. Box 2436 High Point, NC 27261	(910) 885-6085
UL	Underwriters Laboratories Inc. 333 Pfingsten Rd. Northbrook, IL 60062 www.ul.com	(800) 704-4050 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association 2655 Villa Creek Dr., Suite 155 Dallas, TX 75234 members.aol.com/unibell	(972) 243-3902
USITT	USITT: The American Association of Design and Production Professionals in the Performing Arts 6443 Ridings Rd. Syracuse, NY 13206-1111 www.culturenet.ca/usitt	(800) 938-7488 (315) 463-6463
USP	U.S. Pharmacopeia (Formerly: U.S. Pharmacopoeial Convention) 12601 Twinbrook Pkwy Rockville, MD 20852-1790 www.usp.org	(800) 227-8772 (301) 881-0666
WA	Wallcoverings Association 401 N. Michigan Ave. Chicago, IL 60611-4267	(312) 644-6610

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REFERENCES

WASTEC	Waste Equipment Technology Association 4301 Connecticut Ave. NW, Suite 300 Washington, DC 20008	(202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau P.O. Box 23145 Portland, OR 97281-3145	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Formerly: American Window Covering Manufacturers Association) 355 Lexington Ave., 17th Floor New York, NY 10017-6603	(212) 661-4261
WEF	Water Environment Federation (Formerly: Water Pollution Control Federation) 601 Wythe St. Alexandria, VA 22314-1994 www.wef.org	(800) 666-0206 (703) 684-2400
WIC	Woodwork Institute of California P.O. Box 980247 West Sacramento, CA 95798-0247 www.wicnet.org	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association 507 First St. Woodland, CA 95695 www.wmmpa.com	(800) 550-7889 (530) 661-9591
WPCF	Water Pollution Control Federation (See WEF)	
WRI	Wire Reinforcement Institute 301 E. Sandusky St. Findlay, OH 45840 www.bright.net/~rreiter	(419) 425-9473
WSC	Water Systems Council Building C, Suite 20 800 Roosevelt Rd. Glen Ellyn, IL 60137	(630) 545-1762
WSFI	Wood and Synthetic Flooring Institute (See MFMA)	
WWPA	Western Wood Products Association Yeon Building 522 SW 5th Ave. Portland, OR 97204-2122 www.wwpa.org	(503) 224-3930

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REFERENCES

- G. Federal Government Agencies: Names and titles of Federal Government standards- or specification-developing agencies are often abbreviated. The following abbreviations and acronyms referenced in the Contract Documents indicate names of standards- or specification-developing agencies of the Federal Government. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

CE	Corps of Engineers (U.S. Department of the Army) 20 Massachusetts Ave., NW Washington, DC 20314 www.usace.army.mil	(202) 761-0660
	CRD standards are available from: U.S. Army Corps of Engineers Waterways Experiment Station Technical Report Distribution Section Services Branch, TIC 3909 Halls Ferry Rd. Vicksburg, MS 39180-6199	(601) 634-2696
CFR	Code of Federal Regulations (Available from the Government Printing Office) Washington, DC 20401 (Material is usually published first in the "Federal Register.") www.access.gpo.gov	(202) 512-1800
CPSC	Consumer Product Safety Commission East West Towers 4330 East-West Hwy Bethesda, MD 20814 www.cpsc.gov	(800) 638-2772 (301) 504-0990
CS	Commercial Standard (U.S. Department of Commerce) Government Printing Office Washington, DC 20402 For commercial standards, contact: Ms. Brenda Umberger CS & PS Specialist c/o NIST Gaithersburg, MD 20899 www.nist.gov	(202) 512-1800 (301) 975-4036
DOC	Department of Commerce 14th St. and Constitution Ave., NW Washington, DC 20230 www.doc.gov	(202) 482-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590 www.dot.gov	(202) 366-4000

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REFERENCES

EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460 www.epa.gov	(202) 260-2090
FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Ave., SW Washington, DC 20591 www.faa.gov	(202) 366-4000
FCC	Federal Communications Commission 1919 M St., NW Washington, DC 20554 www.fcc.gov	(202) 418-0126
FDA	Food and Drug Administration 5600 Fishers Lane Rockville, MD 20857 www.fda.gov	(301) 443-1544
FHA	Federal Housing Administration (U.S. Department of Housing and Urban Development) 451 Seventh St., SW Washington, DC 20410 www.hud.gov	(202) 401-0388
FS	Federal Specification Unit (Available from GSA) 470 East L'Enfant Plaza, SW, Suite 8100 Washington, DC 20407 www.gsa.gov	(202) 619-8925
GSA	General Services Administration F St. and 18th St., NW Washington, DC 20405 www.gsa.gov	(202) 708-5082
MIL	Military Standardization Documents (U.S. Department of Defense) Defense Automated Printing Service 700 Robbins Ave., Building 4D Philadelphia, PA 19111 www.dodssp.daps.mil	(215) 697-2179
NIST	National Institute of Standards and Technology (U.S. Department of Commerce) Building 101, #A1134, Rte. I-270 and Quince Orchard Rd. Gaithersburg, MD 20899 www.nist.gov	(301) 975-2000

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REFERENCES

OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) 200 Constitution Ave., NW Washington, DC 20210 www.osha.gov	(202) 219-8148
PS	Product Standard of NBS (U.S. Department of Commerce) Government Printing Office Washington, DC 20402 For product standards, contact: Ms. Brenda Umberger CS & PS Specialist c/o NIST Gaithersburg, MD 20899 www.nist.gov	(202) 512-1800 (301) 975-4036
RUS	Rural Utilities Service (Formerly: Rural Electrification Administration) (U.S. Department of Agriculture) 14th St. and Independence Ave., SW Washington, DC 20250	(202) 692-0187
TRB	Transportation Research Board, National Research Council 2101 Constitution Ave., NW Washington, DC 20418 www.nas.edu/trb	(202) 334-2934
USDA	U.S. Department of Agriculture 14th St. and Independence Ave., SW Washington, DC 20250 www.usda.gov	(202) 720-8732
USPS	U.S. Postal Service 475 L'Enfant Plaza, SW Washington, DC 20260-0010 www.usps.gov	(202) 268-2000

1.5 GOVERNING REGULATIONS/AUTHORITIES

- A. The Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents; that information may or may not be of significance to the Contractor. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.
- B. Copies of Regulations: Obtain copies of the following regulations and retain at the Project Site, available for reference by parties who have a reasonable need for such reference.

1.6 SUBMITTALS

- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records

established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

****END OF SECTION****

SECTION 014213
ABBREVIATIONS

C.W.R. Condensing Water Return
C.W.S. Condensing Water Supply
COND. Condensate
COND. Conduit
CONF. Conference
CONN. Connect
C.A.V. Constant Air Volume
CONST. Construction
C.J. Control Joint
CONT. Continue/Continuous
CONTR. Contractor
C.P. Control Panel
CONV. Convector
CNVYR. Conveyor
COR. Corner
C.G. Corner Guard
CORR. Corridor/Corrugated
CPR. Copper
CNTR. Counter
CTSK. Countersink/Countersunk

CRS. Course
COV. Cover
COV.PL. Cover Plate
C.C.T. Cubical Curtain Track
CU.FT. Cubic Feet/Cubic Foot

C.F.M. Cubic Feet Per Minute
C.Y. Cubic Yard
CULV. Culvert
C.D. Cup Dispenser
CYL. Cylinder
CYC. Cycles

D

DMPR. Damper
DMPFG. Dampproofing
D.L. Dead Load
DB. Decibel
D. Deep
DEG. Degree
DMT. Demountable
PARTN. Partition
DEPT. Department
DEPR. Depressed
DES. Design
DET. Detail
D.E.CO. Detroit Edison Co.
DIAG. Diagonal
DGM. Diagram
DIA. Diameter
DIFF. Diffuser
DIM. Dimension
D.R. Dining Room
DIR. Directory
D.D.C. Direct Digital Control
DISC. Disconnect

DISCONT. Discontinuous
DW. Dishwasher
DISP. Dispenser
DIST. Distance
D.P. Distribution Panel
DO. Ditto
DIV. Divider/Division
DR. Door
D.O. Door Opening
DR.OP. Door Operator
DBL. Double
D.A. Double Acting
D.H. Double Hung
DWL. Dowel
DN. Down
D.S. Downspout
D.S.B. Downspout Boot
DRN. Drain
D.T. Drain Tile
D.T.C. Drain Tile Connector
DWR. Drawer
DWG. Drawing
D.F. Drinking Fountain
D.B. Dry Bulb
D.S.P. Dry Stand Pipe
DBWTR. Dumbwaiter
DUP. Duplicate
D.DR. Dutch Door

E

EA. Each
E.F. Each Face
E.W. Each Way
E. East
ELAST. Elastomeric
FLASH. Flashing
ELAST W.P. Elastomeric Waterproofing
E.S.R. Elastomeric Sheet Roofing
E.D.H. Electric Duct Heater
ELEC. Electric/Electrical
ELEC. CL. Electric Closet
ELEC.CAB. Electrical Cabinet
E.C. Electrical Contractor
E- Electrical Drawing Number
E.P. Electrical Panel
E.R.P. Electric Radiant Panel
E.U.H. Electric Unit Heater
EWC Electric Water Cooler
E.W.H. Electric Water Heater
ELEC.OPER. Electrically Operated
EL. Elevation
ELEV. Elevator
EMERG. Emergency
ENCL. Enclosure
ENGR. Engineer

E/E End-to-End
E.A.T. Entering Air Temperature
ENTR. Entrance/Entry
EP. Epoxy
EQ. Equal
EQUIP. Equipment
EQUIV. Equivalent
ESC. Escalator
EST. Estimate
EXC. Excavated
EXH. Exhaust
E.D. Exhaust Duct
E.F. Exhaust Fan
E.G. Exhaust Grille
E.R. Exhaust Register
EXIST. Existing
EXP. Expansion
EXP.B. Expansion Bolt
E.J. Expansion Joint
EXPL.P. Explosion Proof
EXP'D. Exposed
EXT'N. Extension
EXT. Exterior
E.H. Extra Heavy
EXTR. Extruded
E.S.P. External Static Pressure

F

FAB. Fabricated/Fabric
F/F Face-to-face
F. FIN. Factory Finish
F.C.U. Fan Coil Unit
F.S. Far Side
FAS. Fastener
FDR. Feeder
FT. Feet/Foot
F.P.M. Feet Per Minute
FN. Fence
FBD. Fiberboard
FIG. Figure
FIN. Finish/Finished
FIN.FLR/ Finish Floor
F.F.
F.T.R. Finned Tube Radiation
F.A. Fire Alarm
F.A.C.P. Fire Alarm Control Panel
F. BRK. Fire Brick
F.D. Fire Damper
F.E. Fire Extinguisher
F.E.C. Fire Extinguisher Cabinet
F.H.C. Fire Hose Cabinet
F.H. Fire Hydrant
F.L. Fire Line
F.R. Fire Retardant/Fire Rated

SECTION 014213
ABBREVIATIONS

F.V.C. Fire Valve Cabinet
FP. Fireplace
FPRFG. Fireproofing
FIXT. Fixture
FLG. Flange
FLASH. Flashing
F.H.M.S. Flat Head Machine Screw
F.H.W.S. Flat Head Wood Screw
F.C. Flexible Connection
FLR. Floor
F.CO. Floor Cleanout
F.D. Floor Drain
FLR.FIN. Floor Finish
FLUOR. Fluorescent
FLDG. Folding
FTG. Footing
FMBD. Formboard
FDN. Foundation
FR. Frame
FRMG. Framing
F.A.I. Fresh Air Intake
FRZR. Freezer
F.L.A. Full Load Amperes
F.S. Full Size
FURN. Furnish/ Furnished

G

GA. Gauge
GAL. Gallon
G.P.H. Gallons Per Hour
G.P.M. Gallons Per Minute
GALV. Galvanized
GALV.I. Galvanized Iron
G. Gas
GKT. Gasket
G.V. & B. Gate Valve And Box
GA. Gauge
GEN'L. General
GL. Glass
GLZ. Glazing
G.H.T. Glazed Hollow Tile
G.B. Grab Bar
GR. Grade/Grille
GB. Grade Beam
GRAT. Grating
G.L. Grid Line
GRN. Granite
G.S. Grease Separator
G.T. Grease Trap
GND. Ground
G.F. Ground Fault
GT. Grout
GYP. Gypsum
GYP.BD. Gypsum Board

H

HNDCP. Handicapped

H.R. Handrail
H.BD. Hardboard
HDWE. Hardware
HDWD. Hardwood
HD. Head
HDR. Header
H.O.A. Hands-Off-Auto
HD. Head
H.A.GL. Heat Absorbing Glass
H.R.U. Heat Recovery Unit
HTR. Heater
HTG. Heating
H/V. Heating And Ventilating
H.V.A.C. Heating, Ventilating, and Air Conditioning
H.H.W.R. Heating Hot Water Return
H.H.W.S. Heating Hot Water Supply
HGT. Height
HEX. Hexagon
H. High
H.I.D. High Intensity Discharge
H.P. High Point
H.PR. High Pressure
H.S. High Strength
H.S.B. High Strength Bolt
H.V. High Voltage
HWY. Highway
HSTWY. Hoistway
H.C. Hollow Core
H.M. Hollow Metal
HK. Hook
HORIZ. Horizontal/
Horizontally
HP. Horsepower
H.B. Hose Bibb
H.S.P. Hose Stand Pipe
H.V.C. Hose Valve Cabinet
HOSP. Hospital
H.W. Hot Water
H.W.R. Hot Water Return
H.W.S. Hot Water Supply
HR. Hour
H.O. Hub Outlet
HYD. Hydrant/Hydraulic
H. Hydrogen

I

I.D. Identification
INCAND. Incandescent
IN. or " Inch/ Inches
INCIN. Incinerator
INCL. Include/ Including
I.W. Indirect Waste
INFO. Information
I.D. Inside Diameter

I.F. Inside Face
INST'L. Install/ Installation
INSUL. Insulate/ Insulation
I.H. Intake Hood
INT. Interior
INTER. Intermediate
INV. Invert
I.E. Invert Elevation

J

J.C. Janitor Closet
JT. Joint
JST. Joist
J.B. Junction Box
JR. Junior

K

K.P. Kick Plate
KV. Kilovolt
KV.A. Kilovolt Ampere
KW. Kilowatt
K. Kip (1000#)
KIT. Kitchen
K.D. Knock Down
K.O.P. Knock-Out Panel

L

LBL. Label
LAB. Laboratory
LAD. Ladder
L.B. Lag Bolt
LAM. Laminate/ Laminated
LDG. Landing
L- Landscape Drawing Number
LGE. Large
LDRY. Laundry
LAV. Lavatory
L.A.T. Leaving Air Temperature
L.H. Left Hand
L.H.R.B. Left Hand Reverse Bevel
LGTH. Length
LEV. Level
LIB. Library
LT. Light
LPRF. Lightproof
LTG. Lighting
L.P. Lighting Panel
L.R.P. Lighting Receptacle Panel
LTWT. Lightweight

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ABBREVIATIONS

LTWT. Lightweight Concrete
CONC.
LMS. Limestone
LTL. Lintel
L.D. Linear Diffuser
L.C.D. Linear Ceiling
Diffuser
L.F. Linear Feet/Foot
LIQ. Liquid
L.L. Live Load
L.R. Living Room
LOC. Location
LKR. Locker
LG. Long
L.L.H. Long Leg Horizontal
L.L.V. Long Leg Vertical
LVR. Louver
L.O. Louver Opening
L.P. Low Point
L.PR. Low Pressure
LBR. Lumber
LBS. Pounds

M

MACH. Machine
M.B. Machine Bolt
MACH.RM. Machine Room
M.U.A. Make-Up Air
M.A.U. Make-up Air Unit
M.D.P. Main Distribution
Panel
M.S.B. Main Switch Board
MAINT. Maintenance
MH. Manhole
M.V.D. Manual Volume
Damper
MFR. Manufacturer
MAR. Marble
MK. Mark
MAS. Masonry
M.O. Masonry Opening
MATL. Material
MAX. Maximum
MECH. Mechanical
M- Mechanical Drawing
Number
M.C. Medicine Cabinet
MED. Medium
MEMB. Membrane
MET. Metal/ Metallic
M.C.S. Metal Carpet Strip
M.D.S. Metal Divider Strip
M.E.S. Metal Edge Strip
M.L. Metal Lath
M.L.& Metal Lath And
PLAS. Plaster
MET.W.P. Metallic
Waterproofing
MEZZ. Mezzanine

M.D.O.T. Michigan Department
of Transportation
MWK. Millwork
MIN. Minimum
MIR. Mirror
M. & S. Mirror And Shelf
MISC. Miscellaneous
M.I. Miscellaneous Iron
MOD. Model
MON. Monument
M.S. & S. Mop Strip And Shelf
M.O. Motor Operated
M.O.D. Motor Operated
Damper
MLDG. Molding
MTD. Mounted
MTG. Meeting/Mounting
MTD. Mounted
MOV. Moveable
MOV. Moveable Partition
PARTN.
MULL. Mullion
M Thousand
MBH 1000BTU/Hour

N

NAT. Natural
N.S. Near Side
NK. Neck
NEUT. Neutral
N.R.C. Noise Reduction
Coefficient
NOM. Nominal
N.C. Non-Corrosive
NOR. Normal
N.C. Normally Closed
N.O. Normally Open
N North
NOS. Nosing
N.I.C. Not In Contract
N.T.S. Not To Scale
NO. or # Number

O

OBS. Obscure
OBS.GL. Obscure Glass
OFF. Office
O.C. On Center
OPQ. Opaque
OPG. Opening
OPER. Operator
O.B.V.D. Opposed Blade
Volume Damper
OPP. Opposite
OPP.HD Opposite Hand
ORIG. Original
ORN. Ornamental

OZ. Ounce
O/O Out-to-Out
O.A. Outside Air
O.D. Outside Diameter
O.F. Outside Face
O.H.S. Oval Head Screw
OA. Overall
OHD. Overhead
OHD.DR. Overhead Door
OXY. Oxygen

P

PRD. Painted
PR. Pair
PNL. Panel
P.T.D. Paper Towel
Dispenser
P.T.W.R. Paper Towel Waste
Receptacle
PARA. Paragraph
PRL. Parallel
PGK. Parking
P.BD. Particle Board
PRTN. Partition
PASS. Passage
PAT. Patent
PVM.T. Pavement
PVG. Paving
PED. Pedestal
PERF. Perforated
PERIM. Perimeter
PERM. Permanent
PERP. Perpendicular
PHOTO. Photograph
P.H. Physically
Handicapped
PC. Piece
PCS. Pieces
PLAS. Plaster
PL.LAM. Plastic Laminate
PL. Plate
PL.GL. Plate Glass
PLAT. Platform
PLBG. Plumbing
PLYWD. Plywood
PT. Point
P.T. Point of Tangency
P.C. Point of Curvature
POL. Polish/ Polished
PVC. Polyvinylchloride
PORC. Porcelain
PORC. Porcelain Enamel
ENAM.
POR. Porous
PORT. Portable
POS. Position
P.I.V. Post Indicator Valve
LBS. or # Pounds
P.L.F. Pounds Per Linear
Foot

SECTION 014213

ABBREVIATIONS

P.S.F.	Pounds Per Square Foot	R.H.	Relief Hood	SGL.	Single
P.S.I.	Pounds Per Square Inch	REM.	Remove/ Removable	SK.	Sink
P.C.F.	Pounds Per Cubic Foot	REP.	Repair	S.D.	Soap Dispenser
P.P.	Power Panel	REQ'D.	Required	S.C.	Solid Core
P/C	Precast	RESIL.	Resilient	S.T.C.	Sound Transmission Class
P.T.C.	Precast Terrazzo Receptor	RET.	Return	S	South
PREFAB.	Prefabricated	R.A.	Return Air	SP.	Space
PFN.	Prefinished	R.A.D.	Return Air Duct	SPR.	Spare
P.C.T./C.M.	Pressure Control Terminal/Control Module	R.A.F.	Return Air Fan	SPKR.	Speaker
P.G.	Pressure Gauge	REV.	Revised/Revision	SPEC.	Specifications
P.R.G.	Pressure Relief Grille	R.P.M.	Revolutions Per Minute	S.D.	Splitter Damper
P.R.V.	Pressure Reducing Valve	R.	Riser	SPRYD.	Sprayed
PRIM.	Primary	R.H.	Right Hand	SPKLR.	Sprinkler
PROJ.	Project/ Projection	R.H.R.B.	Right Hand Reverse Bevel	SQ.	Square
PROP.	Property/ Proposed	R.O.W.	Right Of Way	S.F.	Square Feet/ Square Foot
P.L.	Property Line	RVT.	Rivet	STAG.	Staggered
P.A.	Public Address	RD.	Road	ST.STL	Stainless Steel
P.S.	Purse Shelf	R.S.C.	Rolling Steel Curtain	STD.	Standard
P.B.	Push Button	RF.	Roof	SP.	Standpipe
		R.C.	Roof Conductor	S.P.	Static Pressure
		R.D.	Roof Drain	STA.	Station
		RF.H.	Roof Hatch	STM.	Steam
		R.T.U.	Roof Top Unit	STL.	Steel
		R.S.	Roof Sump	STL.PL.	Steel Plate
		R.V.	Roof Ventilator	STIFF.	Stiffener
		RFG.	Roofing	STO.FR.	Storefront
	Q	R.W.C.	Rain Water Conductor	STOR.	Storage
		RM.	Room	ST.	Storm
QTY.	Quantity	R.O.	Rough Opening	STR.	Straight
Q.T.	Quarry Tile	RND. or O	Round	ST.	Street
QTR.	Quarter	R.H.M.S.	Round Head Machine Screw	STRUCT.	Structural Drawing Number
QTR.RD.	Quarter Round	R.H.W.S.	Round Head Wood Screw	S.G.F.T.	Structural Glazed Facing Tile
	R	R.T.	Rubber Tile	S.STL.	Structural Steel
				SS.D.	Subsoil Drain
				SS.D.C.	Subsoil Drain Connection
RBT.	Rabbet		S	SUB.	Substation
R.C.P.	Radiant Ceiling Panel			S.A.G.	Supply Air Grille
RAD. or R.	Radius			S.D.	Supply Diffuser/ Duct
R.W.C.	Rain Water Conductor	SAN.	Sanitary	SUBST.	Substitute
R.R.	Railroad	S.N.D.	Sanitary Napkin Dispenser	S.A.R.	Supply Air Register
RECV.	Receive/ Receiving	S.N.R.	Sanitary Napkin Receptacle	S.F.	Supply Fan
RECPT.	Receptacle	SCHED.	Schedule	S.A.	Supply Air
R.P.	Receptacle Panel	SCN.	Screen	S.A.D.	Supply Air Diffuser
REC.	Recess	STG.	Seating	SUPP.	Support
RECIRC.	Recirculation	SECT.	Section	SURF.	Surface/Surfacing
RECT.	Rectangle / Rectangular	SERV.	Service	SUSP.	Suspend/Suspension
RED.	Reducer	SHT.	Sheet	SW.	Switch
RWD.	Redwood	SHTG.	Sheathing	SWBD.	Switchboard
REF.	Refer/Reference	SHT.MET.	Sheet Metal	SWGR.	Switchgear
REFL.	Reflected/Reflective	SH. & P.	Shelf And Pole	SYM.	Symbol/Symmetrical
REFRIG.	Refrigerant	SHWR.	Shower	SYS.	System
REFR.	Refrigerator	S.C.R.	Shower Curtain Rod		T
REG.	Register	S.DR.	Shower Door		
RH.C.	Reheat Coil	SW.	Sidewalk	T.BD.	Tackboard
REINF.	Reinforce/Reinforcing Reinforcement	SIM.	Similar	TAN.	Tangent
				TECH.	Technical

SECTION 014213
ABBREVIATIONS

TEL.	Telephone	U.O.N.	Unless Otherwise	W	West
TEL.CAB.	Telephone Cabinet		Noted	W.B.	Wet Bulb
TV	Television	U.S.A.	Untempered Supply	W.	Wide/Width
TV.M.	Television Monitor		Air	W-x-	Wide Flange Section
TEMP.	Temperature	UR.	Urinal	WT	Wide Flange Tee
TEMP.GL.	Tempered Glass				Section
T.W.	Tempered Water			W.O.	Window Opening
T.U.	Terminal Unit		V	W.GL.	Wire Glass
TERR.	Terrazzo			W.M.	Wire Mesh
T.B.	Test Boring			W/	With
T.	Thermostat	VAC.	Vacuum	W/O	Without
THK.	Thick/Thickness	V.B.	Vacuum Breaker	WD.	Wood
T.S.	Thickened Slab	V.C.O.	Vacuum Cleaner	W.L.	Working Line
M (1000)	Thousand		Outlet	W.PT.	Working Point
K (KIP)	Thousand Pounds	V.BARR.	Vapor Barrier	W.I.	Wrought Iron
THD.	Thread/Threaded	VAR.	Variable		
THRESH.	Threshold	V.A.V.	Variable Air Volume		
THRU.	Through	VARN.	Varnish		Y
T.	Tile	VNR	Veneer		
T./TOIL.	Toilet	V. PLAS.	Veneer Plaster		
T.P.D.	Toilet Paper	V.	Vent	YD.	Yard
	Dispenser	V.T.R	Vent Thru Roof	Y.P.	Yield Point
T.P.H.	Toilet Paper Holder	VENT.	Ventilate/ Ventilation	Y.S.	Yield Strength
T & G	Tongue And Groove	V.I.F.	Verify In Field	YR.	Year
T & B	Top & Bottom	VS.	Versus		
T/C	Top Of Cover/Curb	VERT.	Vertical/Vertically		Z
T/EL.	Top Elevation	VERT.C.	Vertical Curve		
T/F	Top Of Footing	VEST.	Vestibule		
T/M	Top Of Masonry	V.I.	Vibration Isolator		
T/P	To Of Pavement	VNY.	Vinyl	Z.C.	Zinc-Coated
T/R	Top of Rail	V.C.T.	Vinyl Composition		
T/R	Top of Rim		Tile		
T/S	Top of Steel	VIN.FAB.	Vinyl Fabric		
T/W	Top of Wall	V.R.S.	Vinyl Reducer Strip		
T.B.	Towel Bar	VIT.	Vitreous		
T.D.	Towel Dispenser	V.C.P.	Vitrified Clay Pipe		
T.D. & W.R.	Towel Dispenser &	VOL.	Volume		
	Waste Receptacle	V.D.	Volume Damper		
T.G.	Transfer Grille	V	Volts		
TRFR.	Transformer				
TRAN.	Transom				
T	Tread				
T.D.	Trench Drain		W		
T.S.	Tube Section				
T.V.	Turning Vane				
T.T.	Twin Tee				
TYP.	Typical				
	U				
U.C.	Undercut	WAINS.	Wainscot		
U.G.	Underground	W.CAB.	Wall Cabinet		
U.L.	Underwriters'	W.CO.	Wall Cleanout		
	Laboratories, Inc.	W.H.	Wall Hydrant		
ULT.	Ultimate	W/W	Wall-to-wall		
UNFIN.	Unfinished	W.V.	Wall Vent		
U.H.	Unit Heater	WHSE.	Warehouse		
U.SUB.	Unit Substation	W.F.	Wash Fountain		
U.V.	Unit Ventilator	W.	Waste/Watts		
U.S.G.S.	United States	W & V	Waste And Vent		
	Geological Survey	W.R.	Waste Receptacle		
		W.C.	Water Closet		
		W.G.	Water Gauge		
		W.H.	Water Heater		
		WP.	Waterproofing		
		W.P.	Weatherproof		
		W.STPG.	Weatherstripping		
		WT.	Weight		
		W.W.F	Welded Wire Fabric		

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. DRAWINGS AND GENERAL PROVISIONS of Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to work of this section.

1.2 SUBMITTALS

- A. Substitution Request Submittal: Requests for substitution will be considered if presented to the Construction Manager at least 10 days in advance of bid due date.
 - 1. Identify the product, or the fabrication to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
 - b. Samples, where applicable or requested.
 - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
 - d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 - e. A Statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including all related costs under this Contract and excluding Architect's redesign costs, net change, if any, in the Contract Sum, and waiving all claims for additional costs related to the substitution which subsequently became apparent.
 - g. Certification by the Contractor that the substitution proposed is appropriate in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
- B. Product Presentation: Conduct a presentation at the Architect's office if required by the Architect to prove appropriateness to the specified product.
- C. Architect's Action: Within one (1) week of receipt of Bids, the Architect may request additional information or documentation necessary for evaluation of the request. Within two (2) weeks of receipt of the request, or one (1) week of receipt of the additional information or documentation, whichever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute is not made or obtained within the time allocated, use the product specified by name. If acceptance is made prior to award, it will be included in the Contract Amount. If acceptance is made after Award, it will be in the form of a Change Order.

1.3 GENERAL REQUIREMENTS FOR SUBSTITUTIONS

A. Substitutions During Bidding:

1. Substitutions shall be included in the proposal under the following conditions only and shall follow all requirements of "Acceptance of Substitutions."
 - a. When the Contractor is unable to obtain competitive prices from more than one of the specified manufacturers.
 - b. When the Contractor knows of another product of equal or better quality and performance.
 - c. When the Contractor has had unsatisfactory experience with one or more of the specified products or has reason to believe that the specified Manufacturer will not provide the necessary guarantees or assume responsibility for performance.

B. Substitutions After Contract:

1. Substitutions proposed after Award of the contract will only be considered for the following reasons.
2. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

C. Acceptance of Substitutions:

1. Substitutions will be considered for any manufacturer except those followed by the words "No Substitutions" in the Specifications.
2. In all cases where substitutions are proposed by the Contractor, it shall be the sole responsibility of the Contractor to provide adequate data and samples as required by the Architect to evaluate the substitution.
3. The Architect shall not be obliged to justify his reason for rejecting a proposed substitution.
4. In the event that a substitution is accepted conditionally on the Contractor's agreement to assume full responsibility for equality and performance, the Contract shall provide a full value warranty and agree to make good all damages resulting from the failure of the substitute product.

1.4 ACCEPTANCE OF MATERIALS AND MANUFACTURERS

A. Standard Materials:

1. Architect's acceptance applies to the Manufacturer only and shall not act to permit any deviation from other requirements of the Specifications.
2. Acceptance will be based on the Manufacturer's specifications at time of issuance of Bidding Documents. Deviations from such specifications shall be considered as a substitution.

3. Requests for acceptance shall be in tabular form stating Specification paragraph and material selected, except as otherwise provided.
4. Shop Drawings shall not indicate any material for which acceptance has not been received, unless accompanied by a separate request for approval. In no case shall Architect's review and return of Shop Drawings constitute and acceptance of either specified or substitute manufacturers or materials.

B. Materials Involving Supplementary Warranty of Maintenance Contract:

1. These materials shall be submitted as a request for acceptance over the signature of a qualified technical representative in the direct employ of the Manufacturer of such other person as the manufacturer may authorize in writing. Request for acceptance shall contain the following information.
 - a. Name of project.
 - b. Name of Contractor, Subcontractor or other party to whom material is furnished.
 - c. Reference to Specification Section and Article where material is specified and other Contract Documents necessary for identification.
 - d. Statement of acceptance of documents, conditions, and performance requirements:
 - 1) Statement that documents as issued are in accordance with manufacturer's recommendations for use of specified materials, or
 - 2) Recommended modification of detail, use, application or for substitution of different product by same manufacturer as being more suitable for the performance requirements of the warranty.
 - e. Statement that detailed installation instructions will be provided.
 - f. Extent of job site technical services, consultants or instructors proposed, if any.
 - g. Statement that warranty will be provided.
 - h. Special provisions required to keep warranty in force.
2. Requests for acceptance may be in the form of a letter including the above items and addressed to the subcontractor responsible for installation of the material, or may be according to a sample form of Material Proposal, provided by the Architect.
3. Upon receipt of the manufacturer's proposal, the subcontractor shall add his own statement agreeing to comply with the manufacturer's requirements and warranting his own workmanship.
4. The Contractor shall submit letter of endorsement of copies of all documents, including letters of comment, to the Architect for approval. In the event that the request for approval recommends a change in the work, modification of detail, or substitution of material, the Contractor shall indicate his concurrence with the change as being within the scope of the Contract or indicate the change in the Contract Sum for making such change, or state his objections to the change.

****END OF SECTION****

EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for standards of construction operations and procedures of a repetitive or general nature.

1.2 MANUFACTURER'S REVIEW

- A. Manufacturer's review of documents and conditions of use is a statement by the manufacturer or a representative or agent thereof that it has reviewed the documents pertaining to the work and verified the proposed use of the material including details and instructions for applications or installation, is suitable for the intended purpose, and under similar conditions of use.
- B. Obtain and submit a statement from the manufacturer indicating that they have no objection to the proposed details or method of installation, and that instructions for applications or installation are in conformance with manufacturer's recommendations. Statement shall include any additional precautions or protective measures that should be taken.
- C. Manufacturer's review shall recognize adjacent materials and state if there is, in its opinion, a serious question of compatibility including possibility of damage to other materials, or damage to the material or assembly by other materials. Such conditions shall be reconsidered and adjustments made, previous approvals notwithstanding.

1.3 APPROVED APPLICATOR

- A. An approved applicator or installer is one whom the manufacturer has reason to believe is experienced and qualified in the work and is familiar with the product and with the manufacturer's recommendations for use and installation.
- B. Obtain and submit a statement from the manufacturer that the proposed applicator or installer is approved and indicate whether or not this approval is subject to review and observation of the work by the manufacturer's representative.
- C. Manufacturer shall not approve an installer or applicator if, because of past history of performance or other reasons, there is a reasonable doubt that it can be relied upon to perform in accordance with the Contract Documents.
- D. Upon completion of the work, manufacturer shall certify that approved material in the proper quantities have been delivered to the approved applicator for use on the Project.
- E. In the event that manufacturer declines to approve proposed applicator, submit a statement as to whether or not on-site instruction or manufacturer's supervision is recommended.

1.4 MATERIAL HANDLING, STORAGE AND DELIVERY

- A. Where applicable, deliver all packaged materials to the site in manufacturer's original unopened containers.

- B. Properly pack all materials in appropriate containers for shipment. Identify contents with piece marks referenced to shop drawings and as far as possible in some sequence as erection. Provide packing, wrapping and other protection as required to insure satisfactory condition of materials and finishes at time of erection.
- C. Inspection and acceptance will be made on the basis of materials as delivered to the job site.
- D. Provide adequate quantities to allow for damage and breakage during shipment and delivery and for replacement of all materials damaged prior to final acceptance. All such replacement of damaged materials shall be at no additional cost to the Owner.
- E. Store materials and equipment that are subject to degradation by outside exposure in a weathertight enclosure.

1.5 MIXING, THINNING AND STORAGE

- A. Store and mix paints only in areas designated, and provide proper protection for walls and floors.
- B. Mix and thin paints in strict accordance with recommendations of the manufacturer.
- C. Deliver and store paints and flammable materials in the manufacturer's original unopened containers, as far as practicable. Keep partially used materials in tightly closed containers.
- D. Do not store oil or paint soaked rags inside the building. Do not store materials in any room containing a direct-fired heating unit.

1.6 ON SITE INSTRUCTION

- A. On-site instruction shall consist of inspection and instruction performed by a qualified representative of the manufacturer.
- B. Obtain and submit a statement from the manufacturer that its authorized representative will provide the specified inspection and instruction and submit a record of the date on which specified services were provided.
- C. Service shall consist of:
 - 1. Preliminary inspection of substrates and all other conditions that would affect the performance of the work.
 - 2. Give notice of all unacceptable conditions and recommend remedial action.
 - 3. Recommend proper procedures for conditions as encountered at the site.
 - 4. Verify that workers are qualified and have received proper instructions.

1.7 MANUFACTURER'S SUPERVISION

- A. Manufacturer's supervision, in addition to all services specified for on- site instruction, consists of continuing inspection and verification that the work has been performed in accordance with the Contract.
- B. Obtain and submit a statement from the manufacturer that complete supervision will be provided.

- C. Where supervision is specified, all costs shall be included in the Base Bid. Where supervision is recommended as a modification, submit a proposal indicating the extent and additional cost, if any, of such service.
- D. Upon completion submit a report giving dates of inspections and include pertinent information as applicable to the particular trade such as procedures, coats, coverages, tests as necessary to verify conformance and certify that the proper types and quantities of materials were installed.

1.8 WORKMANSHIP

- A. Employ skilled mechanics and fabricate all work in the best and most workman-like manner and in strict accordance with the detail drawings, by fabricating contractors regularly engaged in the particular type or work.
- B. Conform to the acceptable fabrication and erection standards of the manufacturer and to the applicable rulings of Code Authorities.

1.9 FABRICATION

- A. Fabricate and install all items plumb, true, straight, square, level and in proper elevations, plane, locations and alignment with other work. Design all work for adjustment to field connection, fitted with proper joints and intersections, adequately anchored in place. Complete work in every detail.
- B. Design and anchor work so that work will not be distorted not fasteners overstressed from expansion and contraction due to temperature change.
- C. All fasteners for exposed surface where not otherwise indicated shall be concealed.
- D. Fabricated Items:
 - 1. Model numbers of Manufacturers as listed herein are intended to indicate design and detail for each item. Variations affecting function or appearance will not be accepted.
 - 2. Identifying Markings: Where the manufacturer's name, patent number, model number or similar identifying marks are required, locate such markings in as inconspicuous as possible location. In no case will such marks be acceptable as part of the basic design.
 - 3. Hardware for all Units: Concealed fasteners and hardware. Butt hinges are not acceptable as a substitute where item scheduled in Specification is manufactured with concealed pivots or piano hinges.

1.10 INSTALLATION

- A. Accurately locate, carefully plumb and level, and securely attach all accessories.
- B. Provide concealed grounds and backing or other anchorages devices, properly located, as required for fastening.
- C. Use manufacturer's standard mounting devices as best suited to installation conditions and as accepted by the Architect. Make all attachments by positive mechanical fastening devices, except where other installation methods are indicated.

- D. Where so recommended by the manufacturer, install the work under direct supervision of the authorized representative of the manufacturer. Employ workers experienced and qualified in the trade.
- E. Install units true and plumb in the opening maintaining proper contact with frames or adjacent materials and fitting closely to detail at intersection with other materials to provide for proper operation.
- F. Connect and properly adjust all operating devices and equipment to operate smoothly and perfectly.
- G. Upon completion or when directed, conduct careful inspection and correct defective work. Perform necessary adjustments as required to leave the completed installation in efficiently operable condition.

1.11 PREPARATION OF SURFACES FOR COATINGS AND COVERINGS

- A. Inspect all surfaces and verify that all required cants and chamfers are provided, and that all surfaces are free from irregularities of projections that would interfere with proper application.
- B. Thoroughly clean surfaces; remove all loose materials, grease, oil and foreign matter.
- C. Allow surfaces to completely dry before applying materials.
- D. Report all unsatisfactory surfaces to contractor for correction before proceeding. Otherwise proceeding will constitute acceptance of surface by Contractor.
- E. Note: Interior application of solvent type adhesives and systems require special ventilation or special solvents if ventilation is not possible.

1.12 BUILDING-IN, ANCHORS, INSERTS

- A. Unless otherwise stipulated, each trade generally shall promptly furnish anchorage and insert devices, together with adequate setting information, where necessary for building into the work by other trades.
- B. Verify the accuracy of all built-in anchors and inserts.
- C. Delays and errors shall be corrected by the trade responsible therefor.
- D. Power driven anchors of equivalent capacity and function may be accepted, subject to written acceptance, where approved by local jurisdictional authorities.
- E. Do not endanger or alter the work of any other trade without obtaining prior written consent.
- F. Furnish all supports necessary for proper installation of equipment.

****END OF SECTION****

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 02 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
 - 2. Divisions 02 through 35 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

- A. 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.

1.4 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.

1.5 QUALITY ASSURANCE

- A. Roofing: When modifying an existing roof and adding new penetrations comply with the following requirements:
 1. Notify original roof manufacturer prior to beginning any work and comply with all manufacturer guidelines and requirements.
 2. Provide original roof manufacturer with a brief description of the proposed work, including any required submittals.
 3. Work shall not begin until written approval is received from original roof manufacturer.
 4. Work must be done by an approved roofing manufacturer's contractor.
 5. Original roof manufacturer shall inspect all modifications to the original roof system.
- B. Structural Elements: Do not cut and patch the following structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Foundation construction.
 - b. Bearing and retaining walls.
 - c. Structural concrete.
 - d. Structural steel.
 - e. Lintels.
 - f. Timber and primary wood framing.
 - g. Structural decking.
 - h. Stair systems.
 - i. Miscellaneous structural metals.
 - j. Shoring, bracing and sheeting.
 - k. Structural systems of special construction in Division 13 Sections.
- C. Operational Elements: Do not cut and patch the following 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.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related elements:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Fire-protection systems.
 - d. Control systems.
 - e. Communication systems.
 - f. Conveying systems.
 - g. Electrical wiring systems.

- h. Operating systems of special construction in Division 13 Sections.
- D. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Exterior curtain-wall construction.
 - 4. Equipment supports.
 - 5. Piping, ductwork, vessels, and equipment.
 - 6. Noise- and vibration-control elements and systems.
- E. 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.
- 1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.
 - d. Matched-veneer woodwork.
 - e. Preformed metal panels.
 - f. Roofing.
 - g. Firestopping.
 - h. Window wall system.
 - i. Stucco and ornamental plaster.
 - j. Terrazzo.
 - k. Finished wood flooring.
 - l. Fluid-applied flooring.
 - m. Aggregate wall coating.
 - n. Wall covering.
 - o. Swimming pool finishes.
 - p. HVAC enclosures, cabinets, or covers.
 - q. Acoustical Ceilings
 - r. Carpeting
- F. 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.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
 - 1. Existing Roof: The existing roof is a roof system which is still under warranty. Comply with the requirements stated in the "Quality Assurance" paragraph above.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. 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

3.1 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.

3.2 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.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 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.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. 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.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

****END OF SECTION****

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for Completion of Work prerequisites for Project close-out.

1.2 SUBSTANTIAL COMPLETION

- A. Each Contractor shall submit written certification to the Owner that project or designated portion of project is substantially complete.
- B. The Owner and the Architect will make an inspection within seven days after receipt of certification.
- C. Should the Owner and the Architect consider that work is substantially complete:
 - 1. Contractor shall prepare, and submit to the Architect, a list of items to be corrected, as determined by the inspection.
 - 2. The Architect will prepare and issue a Certificate of Substantial Completion, AIA Document G704, complete with signatures of Owner and Contractor, accompanied by Contractor's list to items to be completed or corrected as verified and amended by the Architect.
 - 3. Owner occupancy of project or designated portion of project:
 - a. Contractor shall:
 - 1) Apply for Certification of Occupancy
 - 2) Direct final cleaning
 - b. Owner will occupy Project, under provisions stated in Certificate of Substantial Completion.
 - c. Contractor: Complete work listed for completion or correction, within designated time.
 - d. Should the Architect consider that work is not substantially complete:
 - 1) The Architect shall immediately notify the Contractor, in writing, stating reasons.
 - 2) The Contractor shall complete work, and submit written notice, certifying that the project of designated portion of the project is substantially complete.
 - 3) The Architect will reinspect work.

1.3 FINAL INSPECTION

- A. The Contractor shall submit written certification that:
 - 1. The Contract Documents have been reviewed.
 - 2. The Work has been completed and inspected in accordance with the Contract Documents.

3. Equipment and systems have been tested in presence of the Contractor and are operational.
4. The Project is completed, and ready for final inspection.
5. The Architect will make final inspection after receipt of certification.
6. Should the Architect consider that work is finally complete in accordance with requirements of Contract Documents they shall request project closeout submittals from the Contractor.
7. Should they consider that work is not finally complete:
 - a. They shall notify Contractor, in writing, stating reasons.
 - b. The Contractor shall take immediate steps to remedy the stated deficiencies, and send second written notice certifying that work is complete.
 - c. The Architect will reinspect work.

1.4 SUBMITTALS

- A. Operation and Maintenance Manuals: As specified in respective sections.
- B. Test Reports: As specified in respective sections.
- C. Guarantees: Written guarantees where specified.

****END OF SECTION****

ELECTRONIC PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Specified Herein: General Requirements for preparation and submittal of Project Record Documents.

1.2 DEFINITIONS

- A. Record Documents: Copies of the Contract Documents, Shop Drawings, Product Data and Samples maintained at the site for purpose of recording changes and other project information.
- B. Maintenance and Parts Manuals: Annotated PDF file format Brochures, instructions, parts lists and similar documents, published by manufacturers and suppliers of materials and equipment for purpose of providing information necessary to maintenance, repair and replacement.
- C. "As-Built" Drawings: Except for "as-built" corrections to the Shop Drawings the only record of architectural as-built conditions required will be clean copy of the Contractor's notations on the Record Drawings in Annotated PDF file format, unless otherwise specified.
- D. "As-Built" drawings for Mechanical, Electrical and Life Safety or Security Systems shall be fully dimensioned and detailed drawings, in Annotated PDF file format, showing all systems as they exist at the completion of Work.

1.3 SCHEDULES

- A. Prepare schedule listing required Record Drawings and Maintenance Manual submittals in accordance with "Submittals" Section of this Division 01.
- B. Keep schedule up to date listing record drawings and other documents as they are received from Manufacturers, Suppliers and Subcontractors.
- C. Hold all such material until completion of the project and submit when directed.

1.4 DRAWINGS AND SPECIFICATIONS AT THE SITE

- A. Each Contractor shall maintain at the site and available for reference by the Owner and the Architect one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders and other Modifications applicable to their portion of the Work, in good order and marked to record all changes made during construction.
- B. The Drawings, marked to record all changes made during construction, shall be delivered to the Owner upon completion of the Work in Annotated PDF file format.
- C. Record Documents: At the date of Final Completion and as condition precedent to Final Payment, each Contractor shall furnish the following documents to the Owner:

1. Record Drawings in PDF file format showing the field changes affecting the general construction, mechanical, electrical, and all other Work, and indicating the Work as actually installed in the building.
 - a. These shall consist of carefully drawn markings on a set of black and white prints of the Construction Documents obtained especially for the purpose unless otherwise specified. The prints can be scanned into a PDF file when project is completed or the contractor can keep a Annotated PDF file on site.
 - b. The Contractor shall maintain at the job site one set of Construction Documents and indicate thereon each field change as it occurs.
2. A neatly arranged searchable PDF file containing the wiring and control diagrams, operating and maintenance instructions, cuts of all mechanical and electrical equipment and fixtures, as installed including catalogues or parts lists from the prime manufacturer. Said lists shall not be based on local dealer stock number systems.

1.5 RECORD DRAWINGS

- A. Record Drawings are required to establish the location of concealed work deviations from details or dimensions indicated on the construction drawings. Where location or dimensions of portions of the work is indicated by note or line drawings or otherwise indicated to be at the option of the Contractor, the final determination of such options shall be indicated in the Record Drawings.
- B. Record Drawings are required for information only but are intended to provide complete information for as-built drawings.
- C. Final PDF file record copy of all Shop Drawings shall be submitted showing all corrections made and also indicating all field changes or other variations from the details as originally reviewed by the Contractor and the Architect.

1.6 OPERATING AND MAINTENANCE MANUALS

- A. Prior to completion of work in this Contract, each Contractor shall submit for review by the Architect searchable PDF file of manufacturer's catalog data covering all fixtures, equipment and finish materials incorporated into the project. Manufacturer's catalog data shall include full identification of the equipment or fixture capacities, current characteristics, dimensions, and identification of all replacement parts. Operating instructions for all installed equipment, including supplier's names and telephone numbers shall be placed on or lettered on the front page of each catalog or manual.
- B. Maintenance procedure descriptions shall be submitted for all materials requiring special treatments or continued maintenance work and for all assemblies, which may require parts replacement during the life of the installation. Manuals shall indicate recommended schedule for routine service and shall provide complete instructions for performing such service.
- C. Manuals and catalogs shall be searchable PDF format. Each item shall be tab and shall have an index. All material shall be grouped together by specification number.
- D. Contractor shall arrange and provide for the services of factory representatives or other authorized qualified specialists to provide operating and maintenance instruction sessions

directly with Owner's related operating and maintenance personnel for the systems, equipment and materials involved.

- E. These requirements are in addition to other similar requirements stated elsewhere in the Contract Documents including those of "Warranties" Section of Division 01.
- F. Equipment Operation manuals and operating instructions for each item of mechanical and electrical equipment:
 - 1. Operation and Maintenance Charts: Searchable PDF and one (1) hard copy of an operating and maintenance instruction chart which will incorporate applicable comprehensive descriptive instructions, lay-outs, diagrams or any other information that will necessary and/or of value to the operating and maintenance personnel. Hard copy of the charts shall be framed and glazed and mounted at a designated location, and the other three sets shall be included in the operation and maintenance manuals.
 - 2. Operation and Maintenance Manuals: Searchable PDF file of an operation and maintenance manual which shall contain complete instructions for overall operation and maintenance of the facility and its component parts. The manual shall also contain the operating and maintenance instruction charts as specified.

****END OF SECTION****

SELECTIVE DEMOLITION

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. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Repair procedures for selective demolition operations.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
 - 2. Division 01 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
 - 3. Division 02 Section "Building Demolition" for demolition of entire buildings, structures, and site improvements.
 - 4. Division 23 Sections for demolishing, cutting, patching, or relocating mechanical items.
 - 5. Division 26 Sections for demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where 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 removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

- B. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.5 SUBMITTALS

- A. 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.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of temporary partitions and means of egress.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Predemolition 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.
- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to selective 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 structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
 - 1. If possible, retain original Installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage original Installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Matched-veneer woodwork.
 - b. Preformed metal panels.
 - c. Roofing.
 - d. Window wall system.
 - e. Terrazzo.
 - f. HVAC enclosures, cabinets, or covers.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If 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.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey 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 selective demolition operations.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - 5. Refer to Divisions 15 and 16 for other applicable requirements and limitations.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
- C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- F. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - a. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 2. 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. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. 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.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
 11. Explosives: Use of explosives is not permitted.
- B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items.
 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 Owner's storage area on-site .
 5. Protect items from damage during transport and storage.

- D. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- F. Concrete: Demolish in small sections. Cut concrete to a depth of at least **3/4 inch (19 mm)** at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- G. Structural Steel: Dismantle field connections without bending or damaging steel members. Do not use flame-cutting torches unless otherwise authorized by Architect.
1. Transport steel trusses and joists as whole units without dismantling them further.
- H. Below-Grade Construction: Demolish in sections. Remove below-grade construction, including basements, foundation walls and footings, completely to at least 12 inches below grade unless otherwise indicated on Drawings.
- I. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- J. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- K. Building Components: Remove metal gratings, metal ladders, doors, windows, door hardware, cabinets, mirrors, chalkboards and marker boards, tackboards, toilet accessories, plumbing fixtures, and light fixtures, as whole units, intact and undamaged.
- L. Elevators: Remove as whole units as much as practical.
- M. Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.
- N. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.
- O. Carpet and Pad: Remove in large pieces and roll tightly after removing demolition debris, trash, adhesive, and tack strips.
- P. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.

1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- Q. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.
- R. Existing Utilities: Unless otherwise indicated on Drawings, demolish existing utilities and below-grade utility structures that are within 5 feet (1.5 m) outside of footprint indicated for new construction. Abandon utilities outside this area.
 1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 2 Section "Earthwork."
 2. Piping: Disconnect piping at unions, flanges, valves, or fittings.
 3. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 01 Section "Cutting and Patching."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Items and Construction to Be Removed: As indicated on Drawings.
- B. Existing Items to Be Removed and Salvaged: As indicated on Drawings.
- C. Existing Items to Be Removed and Reinstalled: As indicated on Drawings.
- D. Existing Items to Remain: As indicated on Drawings.

****END OF SECTION****

UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.
- B. The provisions and guidelines indicated in ACI 530.1/ASCE 6/TMS 602 Specification for Masonry Structures (referred to hereinafter as the MSJC Code), current at the time of project bidding shall constitute the masonry standard and shall apply to this Section.

1.2 DESCRIPTION OF WORK

- A. Extent of each type of masonry work is indicated on drawings and schedule.
- B. Types of masonry work required include:
 - 1. Concrete Unit Masonry.
 - 2. Reinforced masonry
- C. Products installed but not furnished under this Section include the following:
 - 1. Division 05 Section "Metal Fabrication" for steel lintels in unit masonry.
 - 2. Division 06 Section "Rough Carpentry" for wood nailers and blocking built into unit masonry.
 - 3. Division 07 Section "Firestop Joint Systems" for head-of-wall joints.
 - 4. Division 08 Section "Standard Steel Doors and Frames" for hollow metal frames in unit masonry openings.

1.3 QUALITY ASSURANCE

- A. Testing Agency Services
 - 1. The Construction Manager/Owner will secure and pay for the services of a qualified, independent materials engineer to perform quality assurance testing of mortar and grout materials, to confirm re-bar and anchorage placement, to verify compliance of materials with specified requirements, to observe and document compliance with hot and cold weather construction methods, and to perform required field and laboratory testing. Testing Agency shall be acceptable to the architect and the owner and shall be licensed to practice in the state in which the project is located.
- B. Masonry Inspection Requirements:
 - 1. Testing Frequency for Non-Essential Facilities - Level B Quality Assurance:
 - a. Assurance level to be in accordance with Table 4 of the MSJC Specification for Masonry Structures.
 - b. Frequency level for Category I, II or III buildings to be in accordance with Table 1704.5.1 Level 1 Special Inspections of the Michigan Building Code.
 - 2. For this project, the testing and inspecting agency will be hired by the Owner or the Owner's representative.

3. Contractor may retain a qualified consultant to review procedures and construction methods to comply with this specification, industry standards and construction codes.
- C. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- D. Masonry Standard: Comply with **the MSJC Code** unless modified by requirements in the Contract Documents.
- E. Single source responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- F. Single source responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths (f'm) at 28 days.
- B. Determine net-area compressive strength (f'm) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in Section 1.4 of the MSJC Code. Provide f'm for concrete masonry construction according to the following:

Use	Compressive Strength, f'm (psi)	Unit Strength (psi)	Grout Strength (psi)	Mortar Type
Typical, unless noted otherwise	20000 min.	2800 min.	2000 min.	M or S

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements.
- B. Shop Drawings: Show fabrication and installation details for the following:
 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- 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.
 - b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 3. For each combination of masonry unit type and mortar type, include a written statement identifying the following:
 - a. Net-area compressive strength of masonry units.
 - b. Mortar type.
 - c. Net-area compressive strength of the completed masonry system determined according to Tables 1 and 2 in Section 1.4 of the MSJC Code.
 4. Each combination of masonry unit type and mortar type specified to be manufactured with integral water repellant.
 5. Each material and grade indicated for reinforcing bars.
 6. Each type and size of joint reinforcement.
 7. Each type and size of anchor, tie, and metal accessory.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports from past projects which were performed in accordance with ASTM C 780, for mortar mixes intended for this project required to comply with property specification.
 2. Include test reports from past projects which were performed in accordance with ASTM C 1019, for grout mixes intended for this project required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in Section 1.4 of **the MSJC Code**.
- F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
1. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with hot-weather requirements.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver masonry materials to project in undamaged condition.
 - B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
 1. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.
 - C. Store cementitious materials off the ground, under cover and in dry location.
 - D. Store aggregates where grading and other required characteristics can be maintained.

- E. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

1.7 PROJECT CONDITIONS

- A. Protection of work: During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.
- B. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- C. Do not apply uniform floor or roof loading for at least 3 days after building masonry walls or columns.
- D. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.
- E. Protect base of walls from rain-splashed mud and mortar splatter by means of covering spread on ground and over wall surfaces.
- F. Protect sills, ledges and projections from droppings of mortar.

1.8 COLD WEATHER PROTECTION

- A. Do not lay masonry units which are wet or frozen.
- B. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
- C. Remove masonry damaged by freezing conditions.
- D. For clay masonry units with initial rates of absorption (suction) which require them to be wetted before laying, comply with the following requirements.
 - 1. For units with surface temperatures above 32°F (0°C), wet with water heated to above 70°F (21°C).
 - 2. For units with surface temperatures below 32°F (0°C), wet with water heated to above 130°F (54°C).
- E. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout.
- F. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected with 10°F (6°C).
 - 1. 40°F (4°C) to 32°F (0°C):
 - a. Mortar: Heat mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C).
 - b. Grout: Follow normal masonry procedures.
 - 2. 32°F (0°C) to 25°F (-4°C):
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.

- b. Grout: Heat grout materials to 90°F (32°C) to produce in-place grout temperature of 70°F (21°C) at end of work day.
 - 3. 25°F (-4°C) to 20°F (-7°C):
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
 - b. Grout: Heat grout materials to 90°F (32°C) to produce in-place grout temperature of 70°F (21°C) at end of work day.
 - c. Heat both sides of walls under construction using salamanders or other heat sources.
 - d. Use windbreaks or enclosures when wind is in excess of 15 mph.
 - 4. 20°F (-7°C) and below:
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C).
 - b. Grout: Heat grout materials to 90°F (32°C) to produce in-place grout temperature of 70°F (21°C) at end of work day.
 - c. Masonry Units: Heat masonry units so that they are above 20°F (-7°C) at time of laying.
 - d. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40°F (4°C) for 24 hours after laying units.
 - 5. Do not heat water for mortar and grout to above 160°F (71°C).
- G. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.
- 1. 40°F (4°C) to 32°F (0°C):
 - a. Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
 - 2. 32°F (0°C) to 25°F (-4°C):
 - a. Completely cover masonry with weather-resistive membrane for at least 24 hours.
 - 3. 25°F (-4°C) to 20°F (-7°C):
 - a. Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
 - 4. 20°F (-7°C) and below:
 - a. Except as otherwise indicated, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40°F (4°C) for 48 hours.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.
1. Provide special shapes where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.
 - a. Provide bullnose units for outside corners unless otherwise indicated.
 - b. Provide CMU Bond Beam units where indicated.
 - c. Supply standard open-end units and open-end bond beam units to facilitate placement of vertical reinforcement. Units shall comply with the material specification of adjacent construction.
 2. Water-Repellent Admixture: All concrete masonry exposed to the exterior shall be manufactured with a liquid water-repellent block admixture intended for use with concrete masonry.
 - a. Products: Dry-Block Block Admixture as manufactured by Grace Construction Products, a unit of W. R. Grace & Co. or approved equal.
- B. Concrete block: Provide units complying with characteristics indicated below for Grade, Type, face size, exposed face and, under each form of block included, for weight classification.
1. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
 - a. Regular (Standard) Concrete Masonry Units using standard aggregate:
 - 1) Manufacturers: Subject to compliance with requirements provide products from one of the following:
 - a) Best Block Company
 - b) Fendt Builder's Supply, Inc.
 - c) National Block Company
 - d) Grand Blanc Cement Products
 2. Grade N.
 - a. Grade N except Grade S may be used above grade in exterior walls with weather protective coatings and in walls not exposed to weather.
 3. Size: Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thicknesses indicated.
 - a. Provide special shape concrete blocks as indicated on drawings.
 4. Hollow Load bearing or Non-load bearing Block: ASTM C 90 and as follows:
 - a. Unit Compressive Strength: Provide units with minimum average net-area compressive strength specified under the Performance Requirements of Article 1.4.B above.
 - b. Exterior Walls: Normal or Medium weight – Cavity/Veneer Walls Only
 - c. Exterior Walls: Normal weight – Singly Wythe Walls
 - d. Interior Load or Non-Load Bearing Walls: Lightweight or Medium weight.

5. Solid Load bearing or Non-load bearing Block: ASTM C 145 and as follows:
- a. Unit Compressive Strength: Provide units with minimum average net-area compressive strength specified under the Performance Requirements of Article 1.4.B above.
 - b. Exterior Walls: Normal or Medium weight – Cavity/Veneer Walls Only
 - c. Exterior Walls: Normal weight – Singly Wythe Walls
 - d. Interior Load or Non-Load Bearing Walls: Lightweight or Medium weight.

2.2 EXTERIOR NON-LOAD BEARING REINFORCED MASONRY WALL SCHEDULE

- A. The following table shall apply to all exterior non-load bearing concrete block masonry unit walls as a minimum requirement unless exceeded by drawing requirements.
- B. All exterior load bearing concrete masonry walls will contain steel reinforcing. See structural drawings or contact the architect for additional information.

*WALL HEIGHT	CMU WALL WIDTH	VERTICAL REINFORCEMENT (FULL WALL HEIGHT)	As = IN ² /L.FT	MAXIMUM HORIZONTAL LOAD	REMARKS
9'-6"	8"	NO REINFORCEMENT	-	15 PSF	
12'-0"	8"	#4 @ 48" O.C.	0.05	20 PSF	
13'-4"	8"	#4 @ 48" O.C.	0.06	24 PSF	
16'-0"	8"	#5 @ 48" O.C.	0.0775	25 PSF	
18'-0"	8"	#5 @ 24" O.C.	0.155	30 PSF	
16'-0"	12"	#5 @ 48" O.C.	0.0775	25 PSF	
18'-0"	12"	#4 @ 32" O.C. OR #5 @ 48" O.C.	0.075 0.0775	32 PSF 32 PSF	
20'-0"	12"	#5 @ 40" O.C.	0.093	30 PSF	
24'-0"	12"	#5 @ 24" O.C.	0.155	32 PSF	
28'-0"	12"	#6 @ 24" O.C.	0.22	28 PSF	
30'-0"	12"	#6 @ 16" O.C.	0.33	27 PSF	
32'-0"	12"	#7 @ 16" O.C. OR 2 #6 @ 32" O.C.**	0.45 0.33	26 PSF 25 PSF	**EACH FACE
34'-0"	12"	#7 @ 8" O.C. OR 2 #7 @ 32" O.C.**	0.90 0.45	29 PSF 29 PSF	**EACH FACE

NOTE: 1. Assume Design Value f'_m = 1,500 psi, F_s = 24,000 psi, M or S Mortar, Medium Weight CMU
 2. *CMU Wall supported height start from foundation (dowels with scheduled reinforcement) and brace at each floor and/or roof level.
 3. Grout cells solid at vertical reinforcements full height.

4. Vertical reinforcement to be placed in center of CMU wall U.N.O.
5. Increase wall reinforcement at the corner of all wall up to 10'-0" horizontally by 50% of scheduled reinforcement.
6. Place two (2) vertical bars of scheduled reinforcement at each side of each masonry opening (i.e. door, window, etc.).

2.3 INTERIOR NON-LOAD BEARING REINFORCED MASONRY WALL SCHEDULE

- A. The following table shall apply to all internal non-load bearing concrete block masonry unit walls as a minimum requirement unless exceeded by drawing requirements.
- B. All interior load bearing concrete masonry walls will contain steel reinforcing. See structural drawings or contact the architect for additional information.

*WALL HEIGHT	CMU WALL WIDT H	VERTICAL REINFORCEMENT (FULL WALL HEIGHT)	As = IN ² /L.FT	REMARKS
10'-0"	6"	NO REINFORCEMENT	-	
10'-0" TO 18'-0"	6"	* #3 @ 32" O.C.	0.0412	* REINFORCEMENT CAN BE ELIMINATED IF WALL SUPPORTED 10'-0" HORIZONTALLY
16'-0"	8"	NO REINFORCEMENT	-	
20'-0"	8"	#3 @ 48" O.C.	0.0275	
24'-0"	8"	#3 @ 48" O.C.	0.0275	
20'-0"	10"	NO REINFORCEMENT	-	
24'-0"	10"	#3 @ 48" O.C.	0.0275	
28'-0"	10"	#4 @ 56" O.C.	0.0433	
30'-0"	10"	#4 @ 48" O.C.	0.05	
22'-8"	12"	NO REINFORCEMENT	-	
32'-0"	12"	#4 @ 72" O.C.	0.0333	
36'-0"	12"	#4 @ 64" O.C.	0.0375	

- NOTE:
1. Assume Design Value $f'm = 1,500$ psi, $F_s = 24,000$ psi, N Mortar, Light Weight CMU.
 2. All masonry wall design for lateral load = 5 PSF (Wind Load).
 3. *CMU wall supported height start from foundation (dowels with scheduled reinforcement) and brace at floor or roof level with minimum 1" space.
 4. Grout cells solid at vertical reinforcements full height.
 5. Vertical reinforcement to be placed in center of CMU wall U.N.O.
 6. Place one (1) vertical bar of scheduled reinforcement at each side of each masonry opening (i.e. door)

2.4 CONCRETE AND MASONRY LINTELS

- A. General: Provide either concrete or masonry lintels, at Contractor's option, complying with requirements below.
- B. Concrete Lintels: Formed-in-place concrete lintels complying with requirements in Division 03 Section "Cast-in-Place Concrete" with the same reinforcing as scheduled Masonry Lintels. Use in hidden or un-exposed conditions only. Temporarily support built-in-place lintels until cured.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.
- B. Masonry Cement: ASTM C 91.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.
- E. Aggregate for Grout: ASTM C 404.
- F. Water: Clean and potable.
- G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units.
 - 1. Products: Dry-Block Mortar Admixture as manufactured by Grace Construction Products, a unit of W. R. Grace & Co. or approved equal.

2.6 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

- A. Materials: Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:
 - 1. Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire and with ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.
- B. Joint Reinforcement: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10', with prefabricated corner and tee units, and complying with requirements indicated below:
 - 1. Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.
 - 2. Wire Size for Side Rods: 0.1483" diameter.

3. Wire Size for Cross Rods: 0.1483" diameter.
 4. For single-wythe masonry provide type as follows with single pair of side rods:
 - a. Ladder design with perpendicular cross rods spaced not more than 16" o.c.
 5. For multi-wythe masonry provide type as follows:
 - a. Ladder design with perpendicular cross spaced not more than 16" o.c. and number of side rods as follows: One side rod for each face shell of concrete masonry back-up and one rod for brick wythe.
 - b. Number of side rods for Composite Construction: One side rod for each face shell of concrete masonry back-up and one rod for brick wythe.
 - c. Use units with adjustable 2-piece rectangular ties where horizontal joints of facing wythe do not align with those of back-up.
 - 1) Products: Subject to compliance with requirements, provide the following:
 - a) "Series 800 Hook and Eye"; Wire Bond.
 - b) "AA525" Adjustable Econo-Eye-Lok", AA Wire Products.
 - c) "Ladur-Eye"; Dur-O-Wal, Inc.
 - d) "Lox-All Adjustable Eye-Wire"; Hohman & Barnard, Inc.
- C. Flexible Anchors: Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.
1. For anchorage to steel framework provide manufacturer's standard anchors which fasten thru exterior sheathing and extent thru rigid insulation.
 - a. Wire Size: 0.1875" diameter.
 - b. Products: Subject to compliance with requirements, provide the following:
 - 1) "HCL-911", Wire-Bond as distributed by Masonpro. Phone No. 800-659-4731
 - 2) RAP-TIE, Fero Corporation as distributed by Masonpro Phone No. 800-659-4731
 2. Joint Stabilizing Anchors: Single-piece assembly with sliding rods held in receiver which allows vertical and horizontal movement but resists tension and compression forces perpendicular to plane of wall.
 - a. Receiver Section: Fabricated with stainless steel 1/32 inch sheet steel sleeves, one side embedded in masonry, the other connected to the steel frame with self tapping screws for full capacity of the anchor assembly.
 - b. Tie Section: Two 8 gauge stainless wires encased in plastic sleeves held in the receiver section.
 - 1) Dur-O-Wal # D/A 2200 or approved equal.
- D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel.

2. Tie Section for Steel Frame : Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel.
- E. Masonry Veneer Anchors (Interior use only): Not less than 22 gauge and not less than 7/8 inch wide and 7 inches long, with one end crimped for attachment to substrate. Size to extend within 3/4" of face of masonry veneer.
- F. Galvanized steel channel slot anchors for anchoring new masonry to existing.
 1. Provide Heckmann No. 133/133-P continuous channel and mounting plate, with standard triangular type wire tie.
- G. Rigid Anchors: Provide straps of form and length indicated, fabricated from metal strips 1-1/2 inches wide x 1/4 inch thick (12 inches long) unless other sizes indicated.
- H. Un-coated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- I. INTERSECTING WALL ANCHORS
 1. Exterior Walls and Interior Bearing Walls: Fabricate steel bars as follows:
 - a. 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.
 - b. Finish: Hot-dip galvanized to comply with ASTM A 153.
 - c. Lay-up in alternate courses between adjacent intersection walls which are not interlocked or at control joint locations.
 2. Interior Non-Bearing Walls and Interior Partitions:
 - a. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

2.7 CONCEALED FLASHING MATERIALS

- A. Sheet Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:
 1. Stainless Steel: 0.015" thick.
- B. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim."
- C. Bituthene Sheet Flashing (Rubberized Asphalt): Flexible sheet flashing especially formulated from modified bituthene flexible and waterproof in concealed masonry applications, black in color and of thickness indicated below:
 1. Thickness: 40 mils.
 2. Manufacturer: W.R. Grace & Co.
 3. Provide stainless steel drip under flexible sheet flashing at lintels and where indicated.
 4. Form end dams at lintel ends.

- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. Product: Subject to compliance with requirements, provide Blok-Flash as manufactured by Eben LLC and distributed by the following:
 - a. Advanced Building Products Inc.
 - b. MASONPRO, Inc.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 for bars No. 3 to No. 18.
- B. Control Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE41E1, capable of compression up to 35%, of width and thickness indicated.
- C. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Steel Column Isolation Material: 1/2 inch thickness asphalt impregnated fiberboard.
- E. Weepholes: Provide full open head joints with Duro-W-Wall "Cell Vent Weep - Hole Ventilator" inserts. Color to be selected by Architect from manufacturer's standards. Spacing shall be as follows:
 1. At Concrete Masonry Units: Provide 2-1/2 inch high weepholes at 32 inches on center.
 2. And as indicated on Drawings.
- F. Cavity Drainage Material: Provide and install "Mortar Net" as distributed by Belden Brick.
 1. Size 10" high x thickness of cavity unless noted otherwise.
- G. Compressible Joint Fillers: For use between the top of unrated masonry walls and the underside of structural steel or roof deck: Closed cell neoprene conforming to the requirements of ASTM D 1056, Grade SCE-42, board stock of sufficient thickness to be under compression when in the joint.
- H. Column Wrap: Wrap steel columns with "Boxboard" 1/4 inch corrugated, asphalt impregnated, cardboard as manufactured by Williams Products.
- I. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.187-inch steel wire, hot-dip galvanized after fabrication.
 1. Provide self-positioning units with either two loops or four loops as needed for number of bars indicated recessed downward into core a minimum of 1-1/4".
 2. Reinforcing Bar Positioners Manufacturer:
 3. Wire-Bond: Core-Lock Seated Rebar Positioner.

2.9 INSULATION

- A. Extruded Polystyrene Board Insulation: Rigid cellular polystyrene thermo insulation with closed cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578, Type IV; 5-year aged r-value of 5 Btu/(hr x sf x °F) at 75°F (24°C); in manufacturer's standard lengths and widths; thicknesses as indicated.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. "Styrofoam Cavtymate Plus"; Dow Chemical USA.
 - b. "Foamular 250"; UC Industries.
 - c. "Certifoam", Minnesota Diversified Products, Inc.
 - d. "Tuff-RC", Celotex
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.10 MASONRY CLEANERS

- A. Job-mixed Detergent Solution: Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.
1. Available Products: Subject to compliance with requirements, a product which may be used to clean unit masonry surfaces includes, but is not limited to, the following:
 - a. "Sure Klean" No. 600 Detergent; ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

- A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.
1. Water-Repellent Admixture: Provide at all mortar joints in concrete masonry exposed to the exterior.
- B. Mixing: Combine and thoroughly mix cementitious, water and aggregate in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.
- C. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- D. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specifications, for types of mortar required, unless otherwise indicated.
1. Limit cementitious materials in mortar to Portland cement-lime.
 2. Use Type M mortar for masonry below grade and in contact with earth, and where indicated.
 3. Use Type M or S mortar for reinforced masonry and where indicated.
 4. For interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

5. For veneers, use Type N. Coordinate with other architectural requirements specified herein for veneer mortars.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 7 of **the MSJC Code** for dimensions of grout spaces and pour height. Fine grout shall not be used unless absolutely necessary to comply with Table 7.
 2. Proportion grout in accordance with ASTM C 476, Paragraph 4.2.2 for specified 28-day compressive strength indicated by Article 1.4.B Performance Requirements of this specification, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Wetting Clay Brick: Wet brick made from clay or shale which have ASTM C 67 initial rates of absorption (suction) of more than 30 grams per 30 sq. in. per minute. Use wetting methods which ensure each clay masonry unit being nearly saturated but surface dry when laid.
- E. Do not wet concrete masonry units.
- F. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- G. Thickness: Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.
- H. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- I. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
- J. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.

1. Use dry cutting saws to cut concrete masonry units.
 - K. Matching Existing Masonry Work: Match coursing, bonding, color and texture of new masonry work with existing work. Tooth masonry infill into existing masonry coursing.
 - L. Bond Break: Provide a continuous bond breaker strip in all mortar joints between clay masonry and concrete masonry.
- 3.2 CONCRETE MASONRY UNIT (CMU) WALL SHALL BE PREPARED AS FOLLOWS TO ACCEPT THE AIR & VAPOR BARRIER:
- A. Surfaces shall be free of contaminants such as grease, oil and wax on surfaces to receive membrane
 - B. The CMU surfaces shall be free from projections.
 - C. Strike all mortar joints flush to the face of the concrete block.
 - D. Fill all voids and holes greater than ¼ inch across at any point with mortar, sealant or other approved fill material.
 - E. Surface irregularities exceeding ¼ inch in height or sharp to touch shall be ground flush or made smooth.
 - F. Fill around all penetrations with mortar, sealant or other approved fill material and strike flush.
 - G. If the surfaces cannot be made smooth to the satisfaction of the Architect, it will be the responsibility of the trade to alternatively apply a parge coat (typically one part cement to three parts sand) over the entire surface to receive Air & Vapor Barrier Membrane
 - H. Remove mortar droppings on brick ties, shelf angles, brick shelves or other horizontal obstructions.
- 3.3 CONSTRUCTION TOLERANCES
- A. Variation From Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.
 - B. Variation From Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.
 - C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
 - D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".
 - E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.4 LAYING MASONRY WALLS:

- A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.
- C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.
 - 1. Grind miter internal corner to match intersection of bullnose.
- D. Stopping and Resuming Work: Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.
- E. Built-in Work: As the work progresses, build-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.
 - 1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 2. Column Wrap: Wrap steel columns with corrugated, asphalt impregnated, cardboard prior to grouting or building into masonry surrounds.
 - 3. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
 - 4. Fill cores in hollow concrete masonry units with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.
- F. Masonry walls indicated to extend to the roof deck shall terminate 1" below the underside of the deck and resulting space shall be filled with a firestop joint assembly suitable for permanent placement and complying with Division 7 Section "Firestop Joint Systems". Provide a 4 x 4 x 12 gauge x 8" long angle at 5'-0" (+ or -) o.c. at each face of wall.
 - 1. Where run of wall is parallel to deck flutes, provide a supplemental 12 gauge plate to link both opposing angles. Width of plate and angles is to be 8".
 - 2. Where run of wall is perpendicular to the deck flutes, the supplemental plate can be omitted and length of angle sized to bridge two flutes. Secure assembly to metal deck with two #12 tech screws per side. Do not weld.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid brick size masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or

grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

- C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.
- D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.
- E. Tool exposed joints slightly concave for brick and slightly concave for block including scored joint using a jointer larger than joint thickness, unless otherwise indicated.
- F. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- G. Set stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Wet joint surfaces thoroughly before applying mortar.

3.6 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

- A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes. Install at not more than 16" o.c. vertically.
 - 1. For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.
- B. Exterior Walls and Intersecting or Abutting Interior Bearing Walls: Unless vertical expansion or control joints are shown at juncture:
 - 1. Provide rigid metal anchors not more than 24 inches o.c. If used with hollow masonry units, embed ends in mortar-filled cores.
 - 2. Lay-up in alternate courses between adjacent intersection walls which are not interlocked or at control joint locations.
- C. Intersecting or Abutting Interior, Non-Bearing Walls and Interior Partitions:
 - 1. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units laid up in alternate courses.

3.7 CAVITY WALLS

- A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.
- B. Tie exterior wythe to back-up with continuous horizontal joint reinforcing, installed in mortar joints at not more than 16" o.c. vertically.
- C. Provide weep holes (2-1/2" high open head joints) in exterior wythe of cavity wall located immediately above ledges and flashing, spaced 24" o.c., unless otherwise indicated.

- D. Provide 10" depth of cavity drainage material located immediately above all lintels, flashings and ledges.

3.8 CAVITY WALL INSULATION

- A. On units of plastic insulation, install small pads of adhesive spaced approximately 1'-0" o.c. both ways on inside face. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.9 HORIZONTAL JOINT REINFORCEMENT

- A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcing a minimum of 6".
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.

3.10 ANCHORING MASONRY WORK:

- A. General: Provide anchor devices of type specified.
 - 1. Anchor masonry to structural members where masonry abuts or faces structural members.

3.11 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms 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: Comply with requirements in **the MSJC Code**.
 - 1. Install reinforcing bar positioners in locations coordinated with the vertical reinforcement spacing. Positioners shall be located accurately to install reinforcement bars in the center of the unit core or offset as specified on the Drawings.
 - a. Based on the size of the vertical wall reinforcement, do not exceed the following maximum vertical spacing of positioners:
 - 1) #3 Bar: 6'-3"
 - 2) #4Bar: 8'-4"
 - 3) #5 Bar: 10'-0"
 - 4) #6 Bar: 12'-6"

5) #7 Bar: 14'-7"

6) #8 Bar: 16'-8"

C. At lap splices, the upper reinforcement bar shall be held within the positioner adjacent to the lower bar being spliced.

D. Reinforcement Splices:

1. The following lap splice requirements shall supersede the MSCJ Code requirements. Specified wall heights refer to the distance from the top of foundation or slab support to the upper joist or beam bearing or slab/deck tie-in elevation. For wall heights which equal the specified limit, the lesser provision may apply. As a minimum, reinforcing bars shall be lapped according to the following:

Wall Configuration	#4 Bar	#5 Bar	#6 Bar	#7 Bar	#8 Bar
8" Walls less than 12 ft. high	20"	32	32	40	40"
8" Walls greater than 12 ft. high	40	48	56	64	72"
10" Walls less than 15 ft. high	20"	32	32	40	40"
10" Walls greater than 15 ft. high	40	48	56	64	72"
12" Walls less than 18 ft. high	20"	32	32	40	40"
12" Walls greater than 18 ft. high	40	48	56	64	72"

E. Grouting:

1. Grouting may not proceed until the grout cavity is inspected, vertical reinforcement spacing and position and lap dimensions are confirmed, and anchor size, spacing and position are confirmed.
2. Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
3. General: Grout the cores of all masonry at all locations of reinforcement, bond beams, bearing plates, anchors and embedded items.
4. Comply with requirements in the MSJC Code for cleanouts and for grout placement, including minimum grout space, maximum lift and pour height, vibration and consolidation.
5. Unless previously approved, limit height of vertical grout lifts to not more than 60 inches.
6. Stop grout placement 1.5 inches lower than top of masonry to form a grout key between successive lifts.

3.12 CONTROL AND EXPANSION JOINTS:

- A. General: Install control and expansion joints in unit masonry where indicated in Drawings but not spaced more than 20'-0" apart. Build-in related items as masonry progresses. Do not form a continuous span through movement joints. Verify control joint locations with Architect.
- B. Form control joints in concrete masonry as follows using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Location and spacing of control joints shall comply with industry standards.
 - 5. Interrupt joint reinforcing each side of joint.
- C. Form expansion joints in brick made from clay or shale as follows:
 - 1. Build flanges of factory-fabricated, expansion-joint units into masonry.
 - 2. Form open joint of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."
- D. Build in horizontal, pressure-relieving joints where required and indicated; construct joints by either leaving an air space or inserting a compressible filler of width required.
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.13 LINTELS:

- A. Provide steel lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Refer to Metal Fabrications specification section additional information.
- B. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.
- C. One end of lintel shall remain un-connected to allow for movement. The choice of which end to remain free is arbitrary, but if possible, it end should be located adjacent to the nearest control joint.

3.14 FLASHING OF MASONRY WORK:

- A. General: Provide concealed flashing in masonry work at, or above, shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar. Extend flashings through exterior face of masonry and turn down to form drip. Do not allow any penetrations in flashing.
- B. Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the

wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills turn up ends not less than 2" to form a pan/end dam.

- C. Fabricate through-wall metal flashings embedded in masonry with ribs formed in sawtooth pattern at 3-inch intervals along length of flashing to provide a 3-way integral mortar bond and weep hole drainage as indicated.
- D. Interlock end joints of deformed metal flashings by over-lapping deformations not less than 1-1/2" and seal lap with elastic sealant.
- E. Install flashing to comply with manufacturer's instructions.
- F. Install single-wythe CMU flashing system to comply with manufacturer's instructions.
- G. Provide weep holes as specified.
- H. Install reglets and nailers for flashing and other related work where shown to be built into masonry work.

3.15 FIELD QUALITY CONTROL

- A. Inspectors: Construction Manager/Owner will engage a qualified, independent agency to perform field inspections and prepare inspection reports.
- B. Testing: Construction Manager/Owner will engage a qualified, independent agency to perform field tests indicated below and prepare test reports.
- C. Quality Assurance Level and Frequency:
 - 1. Testing Frequency for Non-Essential Facilities - Level B Quality Assurance:
 - a. Assurance level to be in accordance with Table 4 of the MSJC Specification for Masonry Structures.
 - b. Frequency level for Category I, II or III buildings to be in accordance with Table 1704.5.1 Level 1 Special Inspections of the Michigan Building Code.
 - c. Note: The MSJC and Michigan Building Codes require inspectors to observe all grouting operations continuously. Communication with inspector is the contractor's responsibility. Grouting shall not proceed until the inspector is onsite and has made the required pre-grouting observations.
 - d. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - e. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, locations and position of reinforcement.
- D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780.
- G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- H. Testing agency will report results of tests and inspections promptly, in detail and in writing to Contractor, Architect and authorities having jurisdiction.
- I. Remove and replace work that does not comply with specified requirements.

- J. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

3.16 REPAIR, POINTING AND CLEANING:

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.
- C. Final cleaning: After mortar is thoroughly set and cured, clean masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - a. Detergent.
 - b. Acidic Cleaner; apply in compliance with directions of cleaner manufacturer.
 4. Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.
 5. Clean stone trim to comply with stone supplier's written instructions.
 - a. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."
- D. Protection: Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

END OF SECTION

METAL FABRICATIONS

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:
 - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 2. Shelf angles.
 - 3. Loose bearing and leveling plates.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
 - 2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.

1.3 DEFINITIONS

- A. Action Submittals: Mandatory submittals by the Contractor which require action on the part of the Construction Manager and Design Professional.
 - 1. Construction Manager: Review, Stamp and Forward to the Design Professional.
 - 2. Design Professional: Review, Stamp and Return to the Construction Manager.
- B. Informational Submittals: Mandatory submittals by the Contractor to the Construction Manager and Design Professional which are not returned but kept by each for their project record.

1.4 ACTION SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.

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METAL FABRICATIONS

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 2. Provide templates for anchors and bolts specified for installation under other Sections.
- C. Delegated-Design Submittal: For installed products 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. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data: For the following:
1. Grout.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 2. Provide allowance for trimming and fitting at site.

1.8 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

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. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- D. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-3.
 - 1. Size of Channels: 1-5/8
 - 2. Depth of Channels: As required by field and framing conditions.
 - 3. Material: Galvanized steel complying with ASTM A 653/A 653M, commercial steel, Type B, with G90 coating.
 - 4. Nominal thickness: As required by field and framing conditions.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
 - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- D. Lag Bolts: ASME B18.2.1.

- E. Wood Screws: Flat head, ASME B18.6.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.
- H. Undercut or Adhesive Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
 - 1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:

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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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts if units are installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where exposed to the elements such as at the Building Exterior as well as interior locations which are humid or corrosive.

2.8 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

2.9 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.10 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates after fabrication.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 1. Use non-shrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations, unless otherwise indicated.
 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

****END OF SECTION****

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY:

- A. Types of work in this section include rough carpentry for the following:
 - 1. Wood grounds, nailers and blocking
 - 2. Fiber reinforced gypsum board sheathing
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 06 Section "Interior Architectural Woodwork" for nonstructural carpentry items exposed to view and not specified in another Section.
 - 2. Division 07 Section "Interior/Exterior Finish System" for interior/exterior finish system.

1.3 DEFINITIONS:

- A. Rough carpentry includes carpentry work not specified in other sections and not exposed to view, except as otherwise indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.

1.6 QUALITY ASSURANCE

- A. Single source responsibility for Fire-Retardant-Treated wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels, provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
- B. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.8 PROJECT CONDITIONS:

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wood Preservative-Treated materials:
 - a. Baxter: J.H. Baxter Co.
 - b. Chemical Specialties, Inc.
 - c. Continental Wood Preservers, Inc.
 - d. Hickson Corp.
 - e. Hoover Treated Wood Products, Inc.
 - f. Osmose Wood Preserving, Inc.
 - 2. Fire-Retardant-Treated Materials, Interior Type A
 - a. Baxter: J.H. Baxter Co.
 - b. Chemical Specialties, Inc.
 - c. Continental Wood Preservers, Inc.

- d. Hickson Corp.
- e. Hoover Treated Wood Products, Inc.
- 3. Fiber Reinforced Gypsum Board Sheathing: Provide one of the following product types:
 - a. Glass-Fiber-Surfaced Gypsum Sheathing Board:
 - 1) Georgia-Pacific Corp., "Dens-Glass Gold"
 - b. Glass-Fiber-Embedded Gypsum Sheathing Board:
 - 1) BPB America Inc., "GlasRoc Brand Sheathing"
 - c. Cellulose-Fiber-Embedded Gypsum Sheathing Board:
 - 1) United States Gypsum Co., "Fiberock Brand Aqua-Tough Sheathing"
- 4. Air-Infiltration Barriers:
 - a. GreenGuard (Max).
 - b. CertainTeed Corp. (CertaWrap).
 - c. DuPont, E. I. du Pont de Nemours and Company (Tyvek Commercial).
 - d. Fiberweb, Inc. (Tygar Weather-Protection Membrane).

2.2 LUMBER, GENERAL:

- A. Lumber Standards: Manufacture lumber to comply with DOC PS 20 "American Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies: Inspection agencies and the abbreviations to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association
 - 2. RIS - Redwood Inspection Service.
 - 3. SPIB - Southern Pine Inspection Bureau.
 - 4. WCLIB - West Coast Lumber Inspection Bureau.
 - 5. WWPA - Western Wood Products Association.
 - 6. APA - American Plywood Association.
- C. Grade Stamps: Factory-mark each piece of lumber 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.
 - 1. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.
 - 2. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by the inspection agency.

- D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
- E. Plywood Standards: Comply with PS1 "U.S. Product standard for Construction and Industrial Plywood" for plywood construction panels and, for products not manufactured under PS1 provision, with APA PRP-108. Furnish panels factory marked with APA trademarks evidencing compliance with grade requirements.

2.3 MISCELLANEOUS LUMBER AND PLYWOOD:

- A. Provide wood for support or attachment of other work including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, or as required, and as follows:
- B. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- C. Grade: Standard Grade light framing size lumber of any species or board size lumber as required. No. 3 Common or Standard grade boards per WCLIB or WWPA rules or No. 3 boards per SPIB rules.
- D. Plywood Grade: APA C-D PLUGGED EXTERIOR, with minimum space rating to suit support spacing and plywood thickness indicated.
- E. Particle Boards: Particle Board Standard: Manufacture and factory-mark each particle board panel to comply with ANSI A208.01 "Mat-Formed Wood Particle Board" for grade indicated.

2.4 MISCELLANEOUS MATERIALS:

- A. Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.
 - 1. Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

2.5 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS:

- A. General: Where lumber or plywood is indicated as preservative- treated wood or is specified herein to be treated, comply with applicable requirements of AWPB Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.
 - 1. Do not use chemicals containing chromium or arsenic.
- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19% and 15%. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
- C. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.6 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
 1. Grade: Construction, Stud, or No.3
 2. Species:
 - a. Douglas fir-larch; WCLIB or WWPA
 - b. Hem-fir; WCLIB or WWPA
 - c. Southern Pine; SPIB
 - d. Douglas fir south; WWPA
 - e. Any species above

2.7 FIBER REINFORCED GYPSUM BOARD SHEATHING

- A. Glass-Fiber-Surfaced Gypsum Sheathing Board: Gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material, surfaced on face and back with glass fiber mats with alkali-resistant coating, and with unsurfaced square edges; complying with ASTM C 1177 and requirements indicated below:
 1. Type: Type X.
 2. Thickness: 5/8 inch.
 3. Size: 4 feet by 8 feet.
- B. Glass-Fiber-Embedded Gypsum Sheathing Board: Paperless gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material and fully embedded glass fiber mats covered with an acrylic coating; unsurfaced square edges; complying with ASTM C 1177 and requirements indicated below:
 1. Type: Type X.
 2. Thickness: 5/8 inch.
 3. Size: 4 feet by 8 feet.
- C. Cellulose-Fiber-Embedded Gypsum Sheathing Board: Paperless gypsum sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material and fully embedded cellulose fiber; built-in water drainage channels embossed on the panel backs; unsurfaced square edges; complying with ASTM C 1177 and requirements indicated below:
 1. Type: Type X.
 2. Thickness: 5/8 inch.
 3. Size: 4 feet by 8 feet.

2.8 AIR INFILTRATION BARRIER

- A. Air retarder complying with ASTM E 1677; made from polyolefins; either cross-laminated films, woven strands, or spun bonded fibers; coated or uncoated; with or without perforations to transmit water vapor but not liquid; and as follows:
 - 1. Minimum Thickness: 3 mils.
 - 2. Minimum Water-Vapor Transmission: 20 perms when tested according to ASTM e 96, Procedure A.
 - 3. Maximum Flame Spread: 25 per ASTM E 84.
 - 4. Maximum Allowable Exposure Time: 3 months.
- B. Provide manufacturer's standard tape to seal joints.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL:

- A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.
- B. Set carpentry work to required levels and lines, with members plumb and true and accurately cut and fitted.
- C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.
- D. Countersink nail heads on exposed carpentry work and fill holes.
- E. Use common wire nails, except as otherwise indicated. Use finishing nails for finish 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; pre-drill as required.
- F. Apply field treatment complying with AWPAC M4 to cut surfaces of preservative treated lumber and plywood.

3.2 WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS:

- A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to form work before concrete placement.
- C. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.3 FIBER REINFORCED GYPSUM BOARD SHEATHING

- A. Examine subframing; verify that surface of framing and furring members to receive sheathing does not vary more than $\frac{1}{4}$ " from the place of faces of adjacent members.
- B. Install sheathing in accordance with manufacturer's instructions and applicable instructions in GA-253 and ASTM C 1280.
 - 1. Use maximum lengths possible to minimize number of joints.
- C. Attach sheathing to metal framing with screws spaced 8" o.c. at perimeter where there are framing supports; and 8" o.c. along intermediate framing in field.
 - 1. Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.
 - 2. Locate fasteners minimum 3/8" from edges and ends of sheathing panels.

3.4 AIR INFILTRATION BARRIER

- A. Cover sheathing with air infiltration barrier as follows:
 - 1. Apply air barrier to comply with manufacturer's printed directions.
 - 2. Apply air infiltration barrier to cover upstanding flashing with 4-inch overlap.
 - 3. Tape all joints.

END OF SECTION

FIRESTOPPING

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 firestopping for the following:
 - 1. Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
 - 4. Sealant joints in fire-resistance-rated construction.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 3 Section "Cast-In-Place Concrete" for construction of openings in concrete slabs.
 - 2. Division 4 Section "Unit Masonry Assemblies" for joint fillers for non-fire-resistive-rated masonry construction.
 - 3. Division 7 Section "Building Insulation" for safig insulation and accessories.
 - 4. Division 7 Section "Joint Sealants" for non-fire-resistive-rated joint sealants.
 - 5. Division 15 Sections specifying ducts and piping penetrations.
 - 6. Division 16 Sections specifying cable and conduit penetrations.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
- B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:

1. Where firestop systems protect penetrations located outside of wall cavities.
 2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
 3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
 4. Where firestop systems protect penetrating items larger than a 4-inch-diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
- D. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
- E. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- F. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:
1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Warnock Hersey, or by another qualified testing and inspecting agency.
 3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with the following requirements:
 - a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
 - b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.
- B. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- C. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
- D. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."
- E. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
- G. Owner will employ and pay a qualified inspection agency to check installed firestopping systems for compliance with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A/D Fire Protection Systems, Inc.
 - 2. DAP, Inc.
 - 3. Firestop Systems, Inc.
 - 4. Hilti Construction Chemicals, Inc.
 - 5. 3M Fire Protection Products
 - 6. Tremco
 - 7. USG, Co.
 - 8. International Protective Coatings Corporation

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semirefractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.
- C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.3 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Ceramic-Fiber and Mastic Coating: Ceramic fibers in bulk form formulated for use with mastic coating, and ceramic fiber manufacturer's mastic coating.
- B. Ceramic-Fiber Sealant: Single-component formulation of ceramic fibers and inorganic binders.
- C. Endothermic, Latex Compound Sealant: Single-component, endothermic, latex formulation.
- D. Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.
- E. Intumescent Putty: Nonhardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum foil on one side.
- G. Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E 136, with flame-spread and smoke-developed ratings of zero per ASTM E 84.
- H. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.

- I. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
- J. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping/ gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) grade for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag grade for openings in vertical and other surfaces.
- L. Solvent-Release-Curing Intumescent Sealant: Solvent-release-curing, single-component, synthetic-polymer-based sealant of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping/ gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) grade for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag grade for openings in vertical and other surfaces.

2.4 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.
- B. Sealant Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.
- C. Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.
 - 1. Additional Movement Capability: Provide sealant with the capability to withstand the following percentage changes in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and remain in compliance with other requirements of ASTM C 920 for uses indicated:
 - a. 50 percent movement in both extension and compression for a total of 100 percent movement.

- b. 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.
- D. Multicomponent, Nonsag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.
 - 1. Additional Movement Capability: Provide sealant with the capability to withstand the following percentage change in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and remain in compliance with other requirements of ASTM C 920 for uses indicated:
 - a. 40 percent movement in extension and 25 percent in compression for a total of 65 percent movement.
 - b. 50 percent movement in both extension and compression for a total of 100 percent movement.
- E. Single-Component, Nonsag, Urethane Sealant: Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.

2.5 MIXING

- A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently

stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 INSTALLING THROUGH-PENETRATION FIRESTOPS

- A. General: Comply with the "System Performance Requirements" article in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

- A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.
- D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.5 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently

bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.6 FIELD QUALITY CONTROL

- A. Inspecting agency employed and paid by Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.
- B. Inspecting agency will report observations promptly and in writing to Contractor and Architect.
- C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.
- D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.7 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they 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 firestopping immediately and install new materials to produce firestopping complying with specified requirements.

****END OF SECTION****

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes joint sealants for the following locations:
 - 1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:
 - a. Control and expansion joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints of stonework set without mortar.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors and windows.
 - f. Control and expansion joints in ceiling and overhead surfaces.
 - g. Other joints as indicated.
 - 2. Exterior joints in horizontal traffic surfaces as indicated below:
 - a. Control and expansion joints in brick pavers.
 - b. Control, expansion, and isolation joints in cast-in-place concrete slabs.
 - c. Tile control and expansion joints.
 - d. Joints between different materials listed above.
 - e. Other joints as indicated.
 - 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - f. Perimeter joints of toilet fixtures.
 - g. Other joints as indicated.
 - 4. Interior joints in horizontal traffic surfaces as indicated below:
 - a. Control and expansion joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

- B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.
- C. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in ~~1/2-inch-~~ (13-mm-) wide joints formed between two ~~6-inch-~~ (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction 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.
- F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- G. Field-Adhesion Test Reports: For each sealant application tested.
- H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

1.7 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 period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
 - 2. When joint substrates are wet.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.9 SEQUENCING AND SCHEDULING

- A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

1.10 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.
- B. Products: Subject to compliance with requirements, provide one of the products specified in each Elastomeric Joint Sealant Data Sheet.
- C. GLAZING SEALANT shall be Dow Corning silicone sealant No. 795 or Tremco "Spectrum 2" or General Electric "Silglaze", in a standard color designated by the Architect.

- D. CONSTRUCTION SEALANT shall be Tremco "Spectrum 3" silicone Type S, Grade-NS. Class 50 or approved equal from Dow Corning or General Electric, in standard color designated by architect.
- E. ACRYLIC LATEX SEALANT shall be one-part conforming to ASTM C-834-76 as manufactured by TREMCO "Tremflex 834", PECORA or PTI. Color shall be selected by the Architect from standard colors. This material shall be used at interior areas around windows, doors, frames, precast concrete slabs, and interior masonry walls.
- F. ACOUSTICAL SEALANT shall conform to ASTM-D-217 and be a synthetic rubber base, as manufactured by TREMCO. This material shall be used wherever interior partitions butt up against exterior walls or drywall ceilings.
- G. ON-GRADE JOINT SEALANT shall be one or two-part, self-leveling pouring grade polyurethane as manufactured by Tremco THC 900/901", Pecora "NR-200", Sonaborn SL-2 or Master Mechanics "Vulkem #245".

2.3 JOINT SEALANT BACKINGS

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Open-cell polyurethane foam.
 - 2. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
 - 3. Proprietary, reticulated, closed-cell polymeric foam, nonoutgassing, with a density of 2.5 pcf and tensile strength of 35 psi per ASTM D 1623, and with water absorption less than 0.02 gms/cc per ASTM C 1083.
 - 4. Any material indicated above.
- C. PRIMER: Provide type as recommended by the sealant manufacturer for the varied joint surfaces.

2.4 COMPRESSION SEALS

- A. Performed Foam Sealant: Manufacturer's standard preformed, precompressed, impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water repellant agent; factory-produced in precompressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to degree specified by manufacturer. Provide products which are permanently elastic, mildew-resistant, non-migratory, nonstaining, compatible with joint substrates and other joint sealers, and comply with the following requirements:
 - 1. Impregnating Agent: Neoprene rubber suspended in chlorinated.
 - 2. Density: 9-10 lb./cu. ft.

3. Backing: Pressure sensitive adhesive, factory applied to one side, with protective wrapping.
4. Color: Manufacturers standard gray at building expansion joint, black at all other locations.
5. Acceptable Manufacturers/Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. [Dayton Superior Specialty Chemicals](#); Polytite Standard.
 - b. [EMSEAL Joint Systems, Ltd.](#); Emseal 25V.
 - c. [Sandell Manufacturing Co., Inc.](#); Polyseal.
 - d. [Schul International, Inc.](#); Sealtite
 - e. [Willseal USA, LLC](#); Willseal 150

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material 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.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - APPLICATION

3.1 SEALANT TYPE DETERMINATION

- A. USE EXTERIOR CONSTRUCTION SEALANT at above-grade exterior joints. Use same sealant at interior side of joint if exterior material is the same through the wall, such as a metal frame or single-wythe block wall.
- B. USE INTERIOR ACRYLIC LATEX SEALANT at all other above-grade interior joints, such as at interior hollow metal frames, wood, stone, brick or drywall, in any combination.
- C. USE PAVING SEALANT at all sealed joints on traffic bearing surfaces and at grade.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from

above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- 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 recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Solvent-Release-Curing Sealant Installation Standard: Comply with requirements of ASTM C 804 for use of solvent-release-curing sealants.
- D. Latex Sealant Installation Standard: Comply with requirements of ASTM C 90 for use of latex sealants.
- E. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 19 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- F. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture, or tear joint fillers.
 - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
 2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- G. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

- H. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide concave joint configuration per Figure 5A in ASTM C 62, unless otherwise indicated.
 - 2. Provide flush joint configuration, per Figure 5B in ASTM C 962, where indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 - 3. Provide recessed joint configuration, per Figure 5C in ASTM C 962, of recess depth and at locations indicated.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they 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 so that and installations with repaired areas are indistinguishable from original work.

****END OF SECTION****

STANDARD STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following products manufactured in accordance with SDI Recommended Standards:
 - 1. Doors: Seamless, hollow or composite construction standard steel doors for interior and exterior locations. (Indicated as Hollow Metal "HM" on the Door Schedules.)
 - 2. Frames: Pressed steel frames for doors, transoms, sidelights, borrowed lights, mullions, interior glazed panels, and other interior and exterior openings of following type: (Indicated as Hollow Metal "HM" on the Door Schedules.):
 - a. Welded unit type.
 - 3. Assemblies: Provide standard steel door and frame assemblies as required for the following:
 - a. Labeled and fire rated.
 - b. Thermal rated (insulated).
 - c. Sound rated (acoustical).
 - 4. Provide factory primed doors and frames to be field painted.
 - B. The following sections contain requirements that relate to this Section:
 - 1. Division 04 Section "Unit Masonry Assemblies" for building in of anchors and grouting of frames in masonry construction.
 - 2. Division 08 Section "Door Hardware" for door hardware.
 - 3. Division 09 Section "Painting" for painting primed doors and frames.
- 1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.
 - B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification:
1. For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches (75 by 127 mm)**.
 2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 8 by 10 inches (203 by 254 mm) to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- E. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.5 QUALITY ASSURANCE

- A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- E. Fire-Rated Door Sidelight and Transom Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-protection-rated door assemblies except for size.
 3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.
- F. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.
- G. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inches high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inches spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide standard steel doors and frames by one of the following:
1. Standard Steel Doors and Frames:
 - a. Ceco Corp.
 - b. Curries Company.
 - c. Republic Builders Products.
 - d. Pioneer Industries.
 - e. Steelcraft

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.
- C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, or drawing quality, ASTM A 642, hot dipped galvanized in accordance with ASTM A 525, with A60 or G60 coating designation, mill phosphatized.
 - 1. Stainless Steel: ASTM Type 2, AISI Type 302, other 300 series to suit specified requirements.
- D. Supports and Anchors: Fabricate of not less than 18-gage sheet steel; galvanized where used with galvanized frames.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize in compliance with ASTM A 153, Class C or D as applicable.
- F. Shop Applied Paint: Apply after fabrication.
 - 1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

2.3 DOORS

- A. Provide metal doors of SDI grades and models specified below or as indicated on drawings or schedules:
 - 1. Interior Doors: ANSI/SDI-100, Grade II, heavy-duty, Level 3 or 4, minimum 18-gage cold-rolled sheet steel faces.
 - a. Troy HS doors B210 and C212 to be 16 gage
 - 2. Exterior Doors: ANSI/SDI-100, Grade III, extra heavy-duty, Level 4, minimum 16-gage hot dipped A60 galvanized steel faces, also galvanized hardware reinforcement.
 - 3. Doors shall have beveled (1/8" in 2") hinge and lock edge with edge seam welded and ground smooth.

2.4 FRAMES

- A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 16-gage cold-rolled steel.
 - 1. Fabricate frames with mitered, coped, or welded corners.
 - 2. Form exterior frames from 14-gage hot dipped A60 galvanized steel.
- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.
- C. Plaster Guards: Provide minimum 26-gage steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.5 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Comply with ANSI/SDI-100 requirements.
 - 1. Internal Construction: Manufacturer's standard honeycomb, polyurethane, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
 - 2. Clearances: Not more than 1/8 inch at jambs and heads except between non-fire-rated pairs of doors not more than 1/4 inch. Not more than 3/4 inch at bottom.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.
- C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.
- E. Fabricate exterior doors, panels, and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gage inverted steel channels.
- F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- G. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236 or ASTM C 976 on fully operable door assemblies.
 - 1. Unless otherwise indicated, provide thermal-rated assemblies with U factor of .13 Btu/(hr x sq ft x deg F.) or better.
- H. Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested in accordance with ASTM E 90, and classified in accordance with ASTM E 413.
 - 1. Unless otherwise indicated, provide acoustical assemblies with sound ratings of STC 33 or better.
- I. Finish Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.
 - 1. For concealed hardware, provide space, cutouts, reinforcing and provisions for fastening in doors and frames, as applicable.
- J. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware to be done at project site.

- K. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.
- L. Shop Painting: Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
 - 1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
 - 2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.
- M. Glazing Stops: Minimum 20 gage steel or .040-inch-thick aluminum.
 - 1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
 - 2. Provide screw applied removable glazing beads on inside of glass, louvers, and other panels in doors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.
- B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames," unless otherwise indicated.
 - 1. Except for frames located at existing concrete, masonry or drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 2. In masonry construction, locate 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry Tee anchors. Provide four (4) wall anchors per jamb for frame over 7'-2" high.
 - 3. At existing concrete or masonry construction, provide 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb, set frames and secure to adjacent construction with bolts and masonry anchorage devices.
 - a. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 4. Install fire-rated frames in accordance with NFPA Standard No. 80.
 - 5. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In closed steel stud partitions, attach wall anchors to studs with screws.

6. At existing in-place drywall partitions install knock down slip-on drywall frames.

C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.

1. Install fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

C. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

****END OF SECTION****

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to of this section.

1.2 SUMMARY

- A. This section includes:
 - 1. Extent and location of each type of flush wood door is indicated on drawings and in schedules.
 - 2. Types of doors required include the following:
 - a. Solid core flush wood doors with wood veneer faces.
 - 3. Factory-finishing of flush wood doors is included in this section.
 - 4. Factory-prefitting to frames and factory-premachining for hardware for wood doors is included in this section.
- B. The following sections contain requirements that relate to this Section:
 - 1. Division 08 Section "Standard Steel Doors and Frames" for steel doors and frames.
 - 2. Division 08 Section "Door Hardware" for door hardware.
 - 3. Division 08 Section "Glazing" for glass and glazing.
 - 4. Division 09 Section "Painting" for painting light frames.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Substitutions for products as specified MUST be submitted in accordance with Division 01. Substitute products not submitted in accordance with Division 1 Section "Product Requirements" will NOT be considered.
- B. Product Data: Door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory-finishing specifications.
- C. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.
 - 1. For factory-premachined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light openings.
- D. Samples: Submit samples, 1-0" square or as indicated, for the following:

1. Doors for Transparent Finish: Door faces with solid wood edging representing typical range of color and grain for each species of veneer and solid lumber required.
2. Factory-Finished Doors: Each type of factory finish required.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Obtain doors from a single manufacturer.
- B. Quality Standards: Comply with the following standards:
 1. NWWDA Quality Standard: I.S.1 "Industry Standard for Wood Flush Doors," of National Wood Window and Door Association (NWWDA).
 2. AWI Quality Standards: "Architectural Woodwork Quality Standards," including Section 1300 "Architectural Flush Doors", of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of NWWDS quality standard.
- C. NWWDA Quality Marking: Mark each wood door with NWWDA Wood Flush Door Certification Hallmark certifying compliance with applicable requirements of NWWDA I.S. 1 Series.
- D. Fire-Rated Wood Doors: Doors 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.
 1. Test Pressure: After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
 2. Oversize, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.
 3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors," as well as with manufacturer's instructions.
- B. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames and hardware, using temporary, removable or concealed markings.

1.6 PROJECT CONDITIONS

- A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location:
 1. Referenced AWI quality standard including Section 100-S-3 "Moisture Content."

1.7 WARRANTY

- A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.
 - 1. Warranty shall also include reinstallation which may be required due to repair or replacement of defective doors where defect was not apparent to hanging.
 - 2. Warranty shall be in effect during following period of time after date of Substantial Completion.
 - 3. Solid Core Interior Doors: Life of Installation.
- C. Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following.
 - 1. Solid Core Doors with Wood Veneer Faces:
 - a. Algoma Hardwoods, Inc.
 - b. Baillargeon Doors, Inc.
 - c. Doors, Incorporated.
 - d. Eggers Industries, Architectural Door Division.
 - e. Marshfield Door Systems.
 - f. Mohawk Flush Doors, Inc.
 - g. Oshkosh Architectural Door Company.

2.2 INTERIOR FLUSH WOOD DOORS

- A. Solid Core Doors for Transparent Finish: Comply with the following requirements:
 - 1. Faces: Rift Cut Red Oak.
 - 2. AWI Grade: Premium, Grade AA
 - 3. Construction: PC-5 (Particleboard core, 5-ply).
 - 4. Blocking: Provide wood blocking in particleboard core as needed to eliminate through-bolting hardware and as follows:
 - a. 5-inch (125 mm) top-rail blocking, in doors indicated to have closers.
 - b. 5-inch (125 mm) bottom-rail blocking, in doors indicated to have kick, mop or armor plates.
 - c. 5-inch (125 mm) mid-rail blocking, in doors indicated to have exit devices.

5. Edge Veneer: Match Door Face, Typical at all doors.

2.3 FIRE-RATED SOLID CORE DOORS

- A. Faces and AWI Grade: Provide faces and grade to match non-rated doors in same area of building, unless otherwise indicated.
- B. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
 1. Provide intumescent strip built inside the door by being embedded beneath the outer stile and has no impact on door appearance or function.
- C. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors as needed to eliminate through-bolting hardware.
 1. 5-inch (125-mm) top-rail blocking.
 2. 4-1/2-by-10-inch (114-by-250-mm) lock blocks or 5-inch (125-mm) mid-rail blocking, in doors indicated to have exit devices.
- D. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance.

2.4 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors and Fire Doors: Manufacturer's standard wood beads matching veneer species of door faces.
 1. Provide manufacturer's standard fire-rated wood beads at fire-rated doors.

2.5 FABRICATION

- A. Fabricate flush wood doors to produce doors complying with following requirements:
 1. Factory-prefit and pre-machine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:
 - a. Comply with tolerance requirements of AWI for pre-fitting. Comply with final hardware schedules and door frame shop drawings and with hardware templates.
- B. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of doors required.
 1. Light Openings: Trim openings with manufacturer's standard wood moldings.

2.6 FACTORY FINISHING

- A. General: Comply with referenced AWI quality standard including Section 1500 "Factory Finishing".
- B. Prefinished wood doors at factory.
- C. Transparent Finish: Comply with requirements indicated for grade, finish system, staining effect and sheen.
 1. AWI Grade: Premium.

2. Finish: Manufacturer's standard finish with performance requirements comparable to either AWI System TR-4 conversion varnish or AWI System TR-6 catalyzed polyurethane.
3. Staining: Match approved sample for color.
4. Effect: Open grain finish.
5. Sheen: Satin-medium rubbed effect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine installed door frames prior to hanging door:
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
 2. Reject doors with defects.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation see Division 8 Section "Finish Hardware" section of these specifications.
- B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and referenced AWI standard and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA No. 80.
- C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 1. Fitting Clearances for Non-Rated Doors: Provide 1/8" at jambs and heads; 1/16" per leaf at meeting stiles for pairs of doors; and 1/8" from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.
 2. Fitting Clearances for Fire-Rated Doors: Comply with NFPA 80.
 3. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.
 4. Bevel fire-rated doors 1/8" in 2" in lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Prefit Doors: Fit to frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation, if fitting or machining is required at the job site.

3.3 ADJUSTING AND PROTECTION

- A. Operation: Re-hang or replace doors which do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to assure that wood doors will be without damage or deterioration at time of Substantial Completion.

****END OF SECTION****

DOOR HARDWARE

PART 1 - GENERAL

- 1.1 Refer to "General and Special Conditions", and "Instructions to Bidders", Division 1 of Specifications. Requirements of these Sections and the project drawings shall govern work in this section.
- 1.2 Work Included:
- A. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.
 - B. Related work:
 - 1. Division 000000 – Procurement and Contracting Requirements
 - 2. Division 010000 – General Requirements
 - 3. Division 060000 – Wood, Plastics, and Composites
 - 4. Division 080000 – Openings
 - 5. Division 100000 – Specialties
 - 6. Division 110000 – Equipment
 - 7. Division 260000 – Electrical
 - 8. Division 270000 – Communications
 - 9. Division 280000 – Electronic Safety and Security
 - C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:
 - 1. Cabinet Hardware.
 - 2. Signs, except as noted.
 - 3. Folding partitions, except cylinders where detailed.
 - 4. Sliding aluminum doors
 - 5. Chain link and wire mesh doors and gates
 - 6. Access doors and panels
 - 7. Overhead and Coiling doors
- 1.3 Quality Assurance
- A. Requirements of Regulatory Agencies:
 - 1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
 - 2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
 - 3. Provide hardware for fire-rated openings in compliance with NFPA 80 and state and local building code requirements. Provide only hardware that has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.

B. Hardware Supplier:

1. Shall be an established firm dealing in contract builders' hardware. He must have adequate inventory, qualified personnel on staff and be located within 100 miles of the project. The distributor must be a factory-authorized dealer for all materials required. The supplier shall be or have in employment an Architectural Hardware Consultant (AHC).

C. Electrified Door Hardware Supplier:

1. Shall be an experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.
2. Shall prepare 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.
3. Shall have experience in providing consulting services for electrified door hardware installations.

D. Pre-installation Meeting:

1. Before hardware installation, General Contractor/Construction Manager will request a hardware installation meeting be conducted on the installation of hardware; specifically that of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products, in conjunction with the hardware supplier for the project, shall conduct the meeting. Meeting to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Meeting to address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation videos.
2. When any electrical or pneumatic hardware is specified this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.
3. Convene one week or more prior to commencing work of this Section.
4. The Hardware Supplier shall include the cost of this meeting in his proposal.

E. Manufacturer:

1. Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

1.4 Submittals:

A. Hardware Schedule

1. Submit number of Hardware Schedules as directed in Division 1.
2. Follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule unless noted otherwise.

3. Schedule will include the following:

- a. Door Index including opening numbers and the assigned Finish Hardware set.
- b. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges	Manufacturer A	Manufacturer B
Lock sets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

- c. Hardware Locations: Refer to Article 3.1 B.2 Locations.
- d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
- e. Hardware Description: Quantity, category, product number, fasteners, and finish.
- f. Headings that refer to the specified Hardware Set Numbers.
- g. Scheduling Sequence shown in Hardware Sets.
- h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
- i. Electrified Hardware system operation description.
- j. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
- k. Typed Copy.
- l. Double-Spacing.
- m. 8-1/2 x 11 inch sheets
- n. U.S. Standard Finish symbols or BHMA Finish symbols.

B. Product Data:

1. Submit, in booklet form Manufacturers Catalog cut sheets of scheduled hardware.
2. Submit product data with hardware schedule.

C. Samples:

1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

D. Key Schedule:

1. Submit detailed schedule indicating clearly how the Owner's final keying instructions have been followed.
2. Submit as a separate schedule.

E. Electrified Hardware Drawings:

1. Submit elevation drawings showing relationship of all electrical hardware components to door and frame. Indicate number and gage of wires required.
 - a. Include wiring drawing showing point to point wire hook up for all components.

- b. Include system operations descriptions for each type of opening; describe each possible condition.
 - F. Submit to General Contractor/Construction Manager, the factory order acknowledgement numbers for the various hardware items to be used on the project. The factory order acknowledgement numbers shall help to facilitate and expedite any service that may be required on a particular hardware item. General Contractor/Construction Manager shall keep these order acknowledgement numbers on file in the construction trailer.
- 1.5 Product Delivery, Storage, and Handling:
- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the contractor.
- 1.6 Existing Conditions:
- A. Where existing doors, frames and/or hardware are to remain, conditions, preparations and functions shall be field verified to confirm compatibility with specified hardware. Where any incompatibility is discovered, notify the contractor or construction manager immediately and provide a suggested solution based on industry standard business practices.
- 1.7 Warranties:
- A. Refer to Division 1 for warranty requirements.
 - B. Special Warranty Periods:
 - 1. Closers shall carry manufacturer's 30-year warranty against manufacturing defects and workmanship.
 - 2. Locksets shall carry manufacturer's 10-year warranty against manufacturing defects and workmanship.
 - 3. Exit Devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
 - 4. Continuous gear hinges shall carry manufacturer's lifetime warranty to be free from defects in material and workmanship.
 - 5. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.
 - C. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work.

PART 2 - PRODUCT

- 2.1 Furnish each category with the products of only one manufacturer unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.
- 2.2 Provide the products of manufacturer designated or if more than one manufacturer is listed, the comparable product of one of the other manufacturers listed. Where only one manufacturer or

product is listed, it is understood that this is the owner's Building Standard and "no substitution" is allowed.

A. Hinges:

1. Furnish hinges of class and size as listed in sets.
2. Numbers used are Ives (IVE).
3. Products of a BHMA member are acceptable.

B. Continuous Gear Hinge:

1. 6063-T6 aluminum alloy, anodized finish (cap on entire hinge painted if specified). Manufacture to template, uncut hinges non-handed, pinless assembly, three interlocking extrusions, full height of door and frame, lubricated polyacetal thrust bearing, fasteners 410 stainless steel plated and hardened. All hinge profiles to be manufactured to template bearing locations, with standard duty bearing configurations at 5-1/8" spacing with a minimum of 16 bearings: and heavy duty at 2-9/16" spacing with a minimum of 32 bearings. Anodizing of material shall be done after fabrication of components so that all bearing slots are anodized.
2. Length: 1" less than door opening height. Fastener 12-24 x 1/2" #3 Phillips keen form stainless steel self-tapping at aluminum and hollow metal doors, 12- 1/2" #3 Philips, flathead full thread at wood doors.
3. Furnish fire rated hinges "FR" at labeled openings.
4. Numbers used are Ives.
 - a. For Wood and Hollow Metal frames;
 - 1) Ives 224HD
 - 2) Equal products by Hager & Select will also be accepted.
 - b. For Aluminum frames;
 - 1) Ives 112HD
 - 2) Equal products by Hager & Select will also be accepted.

C. Flush Bolts:

1. Constant Latching: metal doors:
 - a. Ives FB50 Series
 - b. Equal product of any B.H.M.A. member.
2. Constant Latching: wood doors:
 - a. Ives FB60 Series
 - b. Equal product of any B.H.M.A. member.
3. Manual – wood and metal doors:
 - a. Ives FB458 Series
 - b. Equal product of any B.H.M.A. member.
4. Dust Proof Strikes - furnish with all flush bolts, except at openings having thresholds:
 - a. Ives DP2

- b. Equal product of any B.H.M.A. member.
- D. Locksets and Latchsets - Mortise Type:
 - 1. Function numbers are Corbin-Russwin.
 - a. ML2000 series with LWA lever trim. (No substitutions)
- E. Exit Devices:
 - 1. Function numbers are Von Duprin.
 - a. 98 series. (No substitutions)
 - b. Levers to match lockset design where specified.
- F. Push and Pull Hardware:
 - 1. Push Plates: Ives 8200 Series 4 x 16 x .050 inches.
 - 2. Push Bars: Von Duprin 350
 - 3. Pulls: One inch round rod, straight 12 inch centers.
 - 4. Pull Plates: Ives 8302-8 4 x 16 x .050 inches. 8" center.
 - 5. Vandal Resistant Pulls: Ives VR900 Series. Stainless steel construction 0.120 inches thick.
 - 6. Manufacturer: Provide push and pull hardware from any member of B.H.M.A.
- G. Coordinator – Frame Stop Mounted:
 - 1. Door coordinator shall prevent the active door from closing before inactive door. Stop mounted channel 1-5/8" x 5/8" steel tubing x length to suit door opening. Coordinator shall be UL listed. Furnish filler bars to fill gap between end of coordinator and inactive door frame. Furnish mounting brackets for all stop mounted hardware such as exit device strikes, door closer PA shoes, etc. Coordinators shall be prepared (cutout) at the factory for surface applied or concealed vertical rod panic devices if required.
 - 2. Furnish with carry bar CB1 when required for proper operation.
 - a. Ives COR x length to suit.
 - b. Equal products of any BHMA manufacturer
- H. Closers:
 - 1. Review the door frame and plan details to determine the proper length of arm and the degree of swing. State the degree of door swing in the Hardware Schedule. Provide accessories such as drop and adapter plates, panel adapters, thick-hub shoes, blade stop spacers, and shoe supports as required to install door closers correctly.
 - a. LCN 4000 series. (No substitutions).
- I. Overhead Holders and Stops:
 - 1. Type, function and fasteners must be same as Glynn-Johnson specified. Size per manufacturer's selector chart. Plastic end caps, hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
 - 2. Manufacture products using base material of Brass/Bronze for US3, US4, & US10B finished products and 300 Stainless Steel for US32 & US32D finished products.

3. Type, function, and fasteners must be the same as Glynn-Johnson specified. Size per manufacturer's selector chart.
 - a. Glynn-Johnson

J. Kick Plates:

1. Furnish .050 inches thick, beveled four sides, countersunk fasteners, 10" high x door width less 2" at single doors and less 1" at pairs. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less 2".
2. Any BHMA manufacturing product meeting above is acceptable.

K. Wall Stops:

1. Length to exceed projection of all other hardware. Provide with threaded studs and expansion shields for masonry wall construction. Install with slope at top.
 - a. Ives WS33(X)
 - b. BHMA L12011 or L12021

L. Wall Holders:

1. Products specified by series only; furnish strike length to exceed projection of all other hardware.
 - a. Ives WS40
 - b. Equal products of any BHMA manufacturer

M. Thresholds:

1. 1/2" high - 5" wide unless specified otherwise. Cope at jambs.
2. Furnish full wall opening width when frames are recessed.
3. Cope in front of mullions if thresholds project beyond door faces.
4. Furnish with non-ferrous Stainless Steel Screws and Lead Anchors.
 - a. National Guard as listed in sets
 - b. Equal of Zero or Reese

N. Door Sweeps:

1. Surface Sweeps:
 - a. National Guard as listed in sets
 - b. Equal by Zero or Reese

O. Weather-stripping:

1. Apply to head and jamb stops.
2. Solid Bar stock all sides
 - a. National Guard as listed in sets
 - b. Equal by Zero or Reese

P. Miscellaneous:

1. Furnish items not categorized in the above descriptions but specified by manufacturer's names in Hardware Sets.

Q. Fasteners:

1. Furnish fasteners of the proper type, size, quantity and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames. Furnish full thread wood screws for attachment to solid wood doors and frames. "TEK" type screws are not acceptable.
2. **Sex bolts will not be permitted on reinforced metal doors or wood doors where blocking is specified.**

2.3 Finishes:

- A. Generally, Dark Bronze, US10B / BHMA 613 / 313 / 695 at exterior doors at Athens High School, Barnard Elementary, Bemis Elementary, International Academy and Wass Elementary.
- B. Generally, Dull Chrome, US26D / BHMA 626 / 689 at Troy High School and interior doors at all schools.

2.4 Templates and Hardware Location:

- A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
- B. Furnish metal template to frame/door supplier for continuous hinge.
- C. Refer to Article 3.1 B.2, Locations, and coordinate with templates.

2.5 Cylinders and Keying:

- A. All cylinders for this project will be supplied by one supplier regardless of door type and location.
- B. The Finish Hardware supplier will meet with Architect and/or Owner to finalize keying requirements and obtain keying instructions in writing.
 1. Supplier shall include the cost of this service in his proposal.
- C. Provide a cylinder for all hardware components capable of being locked.
- D. Provide cylinders master and grand master keyed to existing Corbin-Russwin system according to Owner's instructions. Provide change keys, master keys and grand master keys as required by Owner.

PART 3 - EXECUTION

3.1 Installation

A. General:

1. Install hardware according to manufacturers installations and template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.
2. Provide blocking/reinforcement for all wall mounted Hardware.
3. Reinforced hollow metal doors and frames and reinforced aluminum door and frames will be drilled and tapped for machine screws.
4. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.
5. Continuous gear hinges attached to hollow metal doors and frames and aluminum doors and frames: 12-24 x 1/2" #3 Phillips Keenform self-tapping. Use #13 or 3/16 drill for pilot.
6. Continuous Gear Hinges require continuous mortar guards of foam or cardboard 1/2" thick x frame height, applied with construction adhesive.
7. Install weather-strip gasket prior to parallel arm closer bracket, rim exit device or any stop mounted hardware. Gasket to provide a continuous seal around perimeter of door opening. Allow for gasket when installing finish hardware. Door closers will require special templating. Exit devices will require adjustment in backset.

B. Locations:

1. Dimensions are from finish floor to center line of items.
2. Include this list in Hardware Schedule.

CATEGORY

DIMENSION

Hinges	Door Manufacturer's Standard
Flush Bolt Levers	72" and 12"
Levers	Door Manufacturer's Standard
Exit Device Touchbar	Per Template
Straight Pulls	Suitable for Exit Devices
Push Plates	52"
Pull Plates	42"
Wall Stops/Holders	At Head

C. Field Quality Inspection:

1. Inspect material furnished, its installation and adjustment, and instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets and exit devices shall be inspected after installation and after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
3. Closers shall be inspected and adjusted after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
4. A written report stating compliance, and also locations and kinds of noncompliance shall be forwarded to the Architect with copies to the Contractor, hardware distributor, hardware installer and building owner.

D. Technical and Warranty Information:

1. At the completion of the project, the technical and warranty information coalesced and kept on file by the General Contractor/Construction Manager shall be given to the Owner or Owner's Agent. In addition to both the technical and warranty information, all factory order acknowledgement numbers supplied to the General Contractor/Construction Manager during the construction period shall be given to the Owner or Owner's Agent. The warranty information and factory order acknowledgement numbers shall serve to both expedite and properly execute any warranty work that may be required on the various hardware items supplied on the project.
2. Submit to General Contractor/Construction Manager, two copies each of parts and service manuals and two each of any special installation or adjustment tools. Include for locksets, exit devices, door closers and any electrical products.

3.2 Hardware Sets:

HARDWARE SET NO. 01

EACH TO HAVE:

1	EA	ELECTRIC STRIKE	* RE-USE EXISTING *	
1	EA	AUTO OPERATOR	* RE-USE EXISTING *	
6	SET	WEATHER SEAL	(BY FRAME MFR)	
6	EA	THRESHOLD	659	NGP
7	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	
			* RE-USE BALANCE OF EXISTING HDWE *	

FIELD VERIFY THE EXISTING DOOR HARDWARE, PREPARATIONS AND CONDITIONS.

HARDWARE SET NO. 02

EACH TO HAVE:

3	EA	ANCHOR HINGE FILLER	(AS REQUIRED)	
3	EA	CONT. HINGE	224HD	IVE
2	EA	PANIC HARDWARE	98-DT	VON
1	EA	CYLINDER	* RE-USE EXISTING *	
1	EA	ELECTRIC STRIKE	* RE-USE EXISTING *	
2	EA	OH STOP & HOLDER	100H	GLY
1	EA	OH STOP	100SE	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	AUTO OPERATOR	* RE-USE EXISTING *	
3	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS AND CONDITIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 03

EACH TO HAVE:

3	EA	ANCHOR HINGE FILLER	(AS REQUIRED)	
3	EA	CONT. HINGE	224HD	IVE
3	EA	PANIC HARDWARE	98-DT	VON
3	EA	OH STOP & HOLDER	100H	GLY
3	EA	SURFACE CLOSER	4111 EDA	LCN
3	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

FIELD VERIFY THE EXISTING FRAME PREPARATIONS AND CONDITIONS FOR COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 04

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	IVE
2	EA	PANIC HARDWARE	98-EO	VON
2	EA	CONCEALED PULL	(BY DOOR MFR)	
2	EA	OH STOP & HOLDER	100H	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
2	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
2	EA	DOOR SWEEP	(BY DOOR MFR)	
2	EA	THRESHOLD	659	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 05

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	IVE
2	EA	PANIC HARDWARE	98-EO	VON
2	EA	CONCEALED PULL	(BY DOOR MFR)	
2	EA	OH STOP & HOLDER	100H	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
2	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
2	EA	DOOR SWEEP	(BY DOOR MFR)	
2	EA	THRESHOLD	425HD	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 06

EACH TO HAVE:

4	EA	CONT. HINGE	112HD	IVE
3	EA	PANIC HARDWARE	98-EO	VON

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DOOR HARDWARE

1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
1	EA	CYLINDER	* RE-USE EXISTING *	
4	EA	CONCEALED PULL	(BY DOOR MFR)	
4	EA	OH STOP & HOLDER	100H	GLY
4	EA	SURFACE CLOSER	4111 EDA	LCN
4	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
4	EA	DOOR SWEEP	(BY DOOR MFR)	
4	EA	THRESHOLD	425HD	NGP
4	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 07

EACH TO HAVE:

4	SET	WEATHER SEAL	(BY FRAME MFR)	
4	EA	THRESHOLD	659	NGP
4	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	
			* RE-USE BALANCE OF EXISTING HDWE *	

FIELD VERIFY THE EXISTING DOOR HARDWARE, PREPARATIONS AND CONDITIONS.

HARDWARE SET NO. 08

EACH TO HAVE:

1	SET	WEATHER SEAL	(BY FRAME MFR)	
1	EA	THRESHOLD	659	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	
			* RE-USE BALANCE OF EXISTING HDWE *	

FIELD VERIFY THE EXISTING DOOR HARDWARE, PREPARATIONS AND CONDITIONS.

HARDWARE SET NO. 09

EACH TO HAVE:

3	SET	WEATHER SEAL	(BY FRAME MFR)	
3	EA	THRESHOLD	659	NGP
3	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	
			* RE-USE BALANCE OF EXISTING HDWE *	

FIELD VERIFY THE EXISTING DOOR HARDWARE, PREPARATIONS AND CONDITIONS.

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 10

EACH TO HAVE:

8	EA	CONT. HINGE	112HD	IVE
7	EA	PANIC HARDWARE	98-EO	VON
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
1	EA	CYLINDER	* RE-USE EXISTING *	
8	EA	CONCEALED PULL	(BY DOOR MFR)	
8	EA	OH STOP	100S	GLY
8	EA	SURFACE CLOSER	4111 EDA	LCN
8	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
8	EA	DOOR SWEEP	(BY DOOR MFR)	
8	EA	THRESHOLD	425HD	NGP
8	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 11

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954	VON
1	EA	PANIC HARDWARE	98-EO	VON
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
2	EA	CYLINDER	* RE-USE EXISTING *	
2	EA	CONCEALED PULL	(BY DOOR MFR)	
2	EA	SURFACE CLOSER	4111 SHCUSH MC	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
2	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 12

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-EO	VON
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	WALL STOP	WS33X	IVE
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 13

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	STOREROOM LOCK	ML2057 LWA L/O.S. TRIM	C-R
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 SHCUSH SRI	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 14

EACH TO HAVE:

5	EA	ANCHOR HINGE FILLER	(AS REQUIRED)	
5	EA	CONT. HINGE	224HD	IVE
5	EA	DUMMY PUSH BAR	350	VON
5	EA	PULL PLATE	8302 8" 4" X 16"	IVE
5	EA	OH STOP & HOLDER	100H	GLY
5	EA	SURFACE CLOSER	4111 EDA	LCN
5	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
5	SET	SEALS	160S	NGP
			(INSTALL AT JAMBS ONLY)	
5	SET	SEALS	700NA	NGP
			(INSTALL ON HEAD ONLY)	

HARDWARE SET NO. 15

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
1	EA	CYLINDER	* RE-USE EXISTING *	
1	EA	ELECTRIC STRIKE	* RE-USE EXISTING *	
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 16

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-EO	VON
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 17

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
1	EA	CYLINDER	* RE-USE EXISTING *	
1	EA	ELECTRIC STRIKE	* RE-USE EXISTING *	
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	WALL STOP	WS33X	IVE
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 18

EACH TO HAVE:

6	EA	HW HINGE	5BB1HW 4.5 X 4.5	IVE
1	SET	CONST LATCHING BOLT	FB52	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	C-R
1	EA	COORDINATOR	COR X FL	IVE
2	EA	MOUNTING BRACKET	MB	IVE
2	EA	SURFACE CLOSER	4111 SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 19

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	IVE
1	EA	SURFACE BOLT	SB453 12" TB	IVE
1	EA	SURFACE BOLT	SB453 8" TB	IVE
1	EA	STOREROOM LOCK	ML2057 LWA L/O.S. TRIM	C-R
1	EA	CONCEALED PULL	(BY DOOR MFR)	
2	EA	OH STOP & HOLDER	100H	GLY
1	EA	SURFACE CLOSER	4111 EDA SRI	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
2	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 20

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
1	EA	CYLINDER	* RE-USE EXISTING *	
1	EA	ELECTRIC STRIKE	* RE-USE EXISTING *	
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	WALL STOP	WS33X	IVE
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 21

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-EO	VON
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	WALL STOP	WS33X	IVE
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 22

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	STOREROOM LOCK	ML2057 LWA L/O.S. TRIM	C-R
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 SHCUSH SRI	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 23

EACH TO HAVE:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	C-R
1	EA	WALL STOP/HOLDER	WS40	IVE

HARDWARE SET NO. 24

EACH TO HAVE:

* ALL HDWE BY DOOR MFR *

HARDWARE SET NO. 25

EACH TO HAVE:

1	EA	KEYED REMOVABLE MULLION	KR4954	VON
1	EA	CYLINDER	(MATCH EXISTING SYSTEM) * RE-USE BALANCE OF EXISTING HDWE *	C-R

HARDWARE SET NO. 26

EACH TO HAVE:

2	EA	DECORATIVE THRU-BOLT	1" DIAMETER	ROC
			* RE-USE BALANCE OF EXISTING HDWE *	

PROVIDE 1" DIAMETER TAMPER RESISTANT DECORATIVE THRU-BOLTS TO TRIM OUT PREVIOUSLY INSTALLED DOOR PULL THAT MATCH EXISTING DECORATIVE THRU-BOLTS ON ADJACENT LEAF.
COORDINATE WITH EXISTING CONDITIONS.

HARDWARE SET NO. 27

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
1	EA	CYLINDER	(MATCH EXISTING SYSTEM)	C-R
1	EA	DOOR PULL, 1" ROUND	8103EZHD 12" O	IVE
1	EA	OH STOP	100SE	GLY
1	EA	AUTO OPERATOR	* RE-USE EXISTING *	
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	600A	NGP
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 28

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	98-EO	VON
1	EA	DOOR PULL, 1" ROUND	8103EZHD 12" O	IVE
1	EA	OH STOP & HOLDER	100H	GLY
1	EA	SURFACE CLOSER	4021	LCN
1	EA	MOUNTING PLATE	4020-18G	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	600A	NGP
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 29

EACH TO HAVE:

1	EA	REMOVABLE MULLION	SL-60	SPE
2	EA	PANIC HARDWARE	98-EO	VON
1	EA	CYLINDER	(MATCH EXISTING SYSTEM)	C-R
2	EA	OH STOP & HOLDER	81H	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	THRESHOLD	659	NGP
* RE-USE BALANCE OF EXISTING HDWE *				

FIELD VERIFY THE EXISTING DOOR AND FRAME PREPARATIONS AND CONDITIONS FOR
COMPATIBILITY WITH THE SPECIFIED HARDWARE.

HARDWARE SET NO. 30

EACH TO HAVE:

1	EA	PANIC HARDWARE	98-EO	VON
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
2	EA	SURFACE CLOSER	4111 SCUSH	LCN
2	SET	SEALS	700NA	NGP
2	EA	DOOR SWEEP	600A	NGP
2	EA	THRESHOLD	659	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	
* RE-USE BALANCE OF EXISTING HDWE *				

FIELD VERIFY THE EXISTING PREPARATIONS AND CONDITIONS.

HARDWARE SET NO. 31

EACH TO HAVE:

4	EA	CONT. HINGE	112HD	IVE
3	EA	PANIC HARDWARE	98-EO	VON
1	EA	PANIC HARDWARE	98-NL-OP-110MD	VON
1	EA	CYLINDER	* RE-USE EXISTING *	
4	EA	DOOR PULL, 1" ROUND	8103EZHD 12" O	IVE
4	EA	OH STOP & HOLDER	100H	GLY
4	EA	SURFACE CLOSER	4021	LCN
4	EA	MOUNTING PLATE	4020-18G	LCN
4	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
4	EA	DOOR SWEEP	600A	NGP
4	EA	THRESHOLD	425HD	NGP
4	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 32

EACH TO HAVE:

1	EA	CONT. HINGE	112HD	IVE
1	EA	STOREROOM LOCK	ML2057 LWA L/O.S. TRIM	C-R
1	EA	CONCEALED PULL	(BY DOOR MFR)	
1	EA	SURFACE CLOSER	4111 HEDA SRI	LCN
1	EA	WALL STOP	WS33X	IVE
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR SCOPE	* RE-USE EXISTING *	
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 33

EACH TO HAVE:

1	EA	CONT. HINGE	224HD	IVE
1	EA	STOREROOM LOCK	ML2057 LWA L/O.S. TRIM	C-R
1	EA	DOOR PULL	VR900	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	SET	SEALS	700NA	NGP
1	EA	DOOR SWEEP	600A	NGP
1	EA	THRESHOLD	425HD	NGP
1	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

HARDWARE SET NO. 34

3	EA	5" HINGE FILLER	(AS REQUIRED)	
1	EA	CONT. HINGE	157XY	IVE
2	EA	DECORATIVE THRU-BOLT	1" DIAMETER	ROC
* RE-USE BALANCE OF EXISTING HDWE *				

PROVIDE 1" DIAMETER TAMPER RESISTANT DECORATIVE THRU-BOLTS TO TRIM OUT PREVIOUSLY INSTALLED DOOR PULL THAT MATCH EXISTING DECORATIVE THRU-BOLTS ON ADJACENT LEAF.
COORDINATE WITH EXISTING CONDITIONS.

HARDWARE SET NO. 35

EACH TO HAVE:

12	EA	5" HINGE FILLER	(AS REQUIRED)	
4	EA	CONT. HINGE	157XY	IVE
2	EA	THRESHOLD	653	NGP
8	EA	DECORATIVE THRU-BOLT	1" DIAMETER	ROC
* RE-USE BALANCE OF EXISTING HDWE *				

PROVIDE 1" DIAMETER TAMPER RESISTANT DECORATIVE THRU-BOLTS TO TRIM OUT PREVIOUSLY INSTALLED DOOR PULL THAT MATCH EXISTING DECORATIVE THRU-BOLTS ON ADJACENT LEAF.
COORDINATE WITH EXISTING CONDITIONS.

HARDWARE SET NO. 36

EACH TO HAVE:

6	EA	HW HINGE	5BB1HW 4.5 X 4.5	IVE
1	SET	CONST LATCHING BOLT	FB52	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	C-R
1	EA	COORDINATOR	COR X FL	IVE
2	EA	MOUNTING BRACKET	MB	IVE
2	EA	OH STOP	90S	GLY
2	EA	SURFACE CLOSER	4011	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE

HARDWARE SET NO. 37

EACH TO HAVE:

2	EA	CONT. HINGE	112HD	IVE
2	EA	SURFACE BOLT	SB453 8" TB	IVE
1	EA	STOREROOM LOCK	ML2057 LWA L/O.S. TRIM	C-R
1	EA	CONCEALED PULL	(BY DOOR MFR)	
2	EA	OH STOP & HOLDER	100H	GLY
1	EA	SURFACE CLOSER	4111 EDA SRI	LCN
1	SET	WEATHER SEAL	(BY DOOR & FRAME MFR)	
1	EA	DOOR SWEEP	(BY DOOR MFR)	
1	EA	THRESHOLD	425HD	NGP
2	EA	DOOR POSITION SWITCH	* BY SECURITY CONTRACTOR *	

SECTION 087100
DOOR HARDWARE

HARDWARE SET NO. 38 (FOR DOOR 150 @ ADMIN BLDG)

EACH TO HAVE:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	C-R
1	EA	OH STOP	410S	GLY

HARDWARE SET NO. 39 (FOR DOOR IAE-B116)

EACH TO HAVE:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	626	C-R
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS33X	626	IVE

HARDWARE SET NO. 40 (FOR TROY HS GYM)

OPENING NO.

TR-B210A	TR-B210B	TR-B210C	TR-B210D	TR-B210E	TR-B210F
TR-B210G	TR-B210H				

EACH TO HAVE:

2	EA	CONT. HINGE	224XY	628	IVE
1	EA	KEYED FIRE RATED REMOVABLE MULLION	KR9954	689	VON
2	EA	FIRE EXIT HARDWARE	98-L-F-03-SNB	626	VON
3	EA	CYLINDER	(MATCH EXISTING SYSTEM)	626	C-R
2	EA	CLOSER	(RE-USE EXISTING)		
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

END OF SECTION

GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Storefront framing.
 - 4. Glazed entrances.
 - 5. Interior borrowed lites.
- B. Safety Glass Where Required: Meet or exceed applicable current requirements of ANSI Z97.1 "Safety Glazing" and CPSC 16 CFR, Category II.

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: Not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."
 - b. Specified Design Snow Loads: Not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."
 - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.
 - 1) For monolithic-glass lites heat treated to resist wind loads.
 - 2) For insulating glass.
 - 3) For laminated-glass lites.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 1/4 inch thick.
 - 2. For laminated-glass lites, properties are based on products of construction indicated.
 - 3. For insulating-glass units, properties are based on units with lites 1/4 inch thick and a nominal 1/2-inch- (12.7-mm-) wide interspace.
 - 4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).

- b. Solar Heat Gain Coefficient: NFRC 200.
- c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
 - 1. Samples:
 - 2. Each type and thickness of glass: three (1) sample, 12 inches square.
 - 3. Gaskets and Tapes: Three (3) samples, 6 inches long; each type and shape; molded corners for each type of gasket.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain glass through one source from a single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
- E. Glazing for Fire-Rated Window Assemblies: Glazing for assemblies that comply with NFPA 80 and 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 257.
- F. Safety Glazing Products including wired glass: Comply with testing requirements in CPSC 16 CFR 1201, Category II and ANSI Z97.1.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
 - 2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. (0.84 sq. m) in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. (0.84 sq. m) or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
1. Insulating Glass Certification Council.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Primary Glass Manufacturers:
 - a. AFG Industries, Inc.
 - b. Guardian Industries, Inc.
 - c. Pilkington Building Products North America
 - d. PPG Industries, Inc.
 - e. Viracon
 - f. Visteon Corp.

2.2 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

2. Heat Strengthened: Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 3. Tempered: Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
- C. Tinted Glass:
1. Product: Subject to compliance with requirements, provide Solarban 60 SOLARGRAY as manufactured by PPG Industries, Inc. or equal by one of the above listed primary glass manufacturers
 2. Color: Gray
 3. Comply with the following properties for one-inch insulating glass with Low-E Coating:
 - a. Visible Light Transmittance: 35%
 - b. Summer U-Value: 0.27
 - c. Winter U-Value: 0.29
 - d. Solar Heat Gain Coefficient: 0.25
 - e. Shading Coefficient: 0.29
- D. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:
1. Interlayer: Polyvinyl butyral of 0.060 inch thickness unless indicated otherwise with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
 - a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.
 2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.
- E. Wired Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Quality-Q-6; and of form and mesh pattern specified.
1. UL label required on all lites.
 2. Comply with testing requirements in CPSC 16 CFR 1201, Category II.
- F. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

4. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Polyisobutylene and polysulfide or silicone.
 - 1) Silicone seal is required for all four sided or two sided structural glazing.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - a. Spacer Material:
 - 1) Aluminum with mill or clear anodic finish for non-structurally glazed applications
 - 2) Aluminum with black, color anodic finish for structurally glazed applications.
 - b. Desiccant: Molecular sieve, silica gel, or blend of both.
 - c. Corner Construction: Manufacturer's standard corner construction.
- G. Low Emissivity-Coated Insulating Glass Units (Low-E): Manufacturer's standard unit with one pane coated with pyrolytic or sputtered, neutral colored, Low-E coating, on third surface of tinted insulating unit or second surface of clear insulating unit. See glass schedule for types and thicknesses.
 1. Pyrolytic-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture, and complying with other requirements specified.
 2. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.
- H. Spandrel Glass:
 1. All glass will be fully tempered.
 2. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
 3. Opacifier material will be either a ceramic frit or silicone opacicoat.
 - a. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one surface ceramic coated), Type I (transparent flat glass), Quality-Q3, and complying with other requirements specified.
 - b. Coated Spandrel Float Glass: Float glass complying with other requirements specified and with the following:
 - 1) Factory apply manufacturer's standard opacifier of the following material to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA Tempering Division's "Engineering Standards Manual."
 - a) Silicone opacifier material.

- I. One-way Vision Glass: Observation glass shall conform to pyrolytic-coated float glass, ASTM C 1376, with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture. Comply with the following:
 1. Ideal lighting ratio: 7:1
 2. Color by Reflection: Silver
 3. Surface Reflection: 38%
 4. Type: 1/4" Laminated
 5. Subject to compliance with requirements provide the following product or approved equal:
 - a. Laminated Mirrorpane as manufactured by Pilkington.

2.3 FIRE-RATED GLAZING PRODUCTS

- A. Film-Faced Ceramic Glazing Material: Proprietary Category II safety glazing product in the form of a 3/16-inch- (5-mm-) thick, ceramic glazing material polished on both surfaces, faced on one surface with a clear glazing film, and as follows:
 1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Product: "FireLite NT" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.or SuperlitCSP
- B. Specially Tempered Monolithic Glass: Proprietary Category II safety glazing product in the form of a specially tempered 1/4-inch- (6.4-mm-) thick monolithic lite, and as follows:
 1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Product: Subject to compliance with requirements, "SuperLite 1" by SAFTI; a Division of O'Keeffe's Inc.
- C. Gel-Filled, Dual-Glazed Units: Proprietary Category II safety glazing product in the form of two lites of Condition A (uncoated surfaces), Type I (transparent flat glass), Class 1 (clear), Kind FT (fully tempered) float glass; with a perimeter metal spacer separating lites and dual-edge seal enclosing a cavity completely filled with clear, fully transparent, heat-absorbing gel.
 1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Product: Subject to compliance with requirements, "SuperLite II XL" by SAFTI; a Division of O'Keeffe's Inc.

2.4 LAMINATED AND INSULATED METAL PANELS

- A. 1/4" Laminated Metal Glazing Panels: Panels shall consist of a laminated sandwich of exterior grade plywood core substrate and stucco embossed aluminum skins 0.028" thick minimum. The entire sandwich shall be bonded under heat and pressure with permanently elastic neoprene contact adhesive.

1. Panel Thickness: 1/4 inch unless indicated otherwise.
 2. Color: PVDF/Kynar 500 – Medium Bronze.
 3. Interior Finish: same as face sheet.
 4. Manufacturer: Subject to compliance with requirements, provide Laminators Inc. “Omega-Ply” System or approved equal.
- B. Insulated Metal Glazing Panels: Panels shall consist of a laminated sandwich of polyisocyanurate insulation core, 0.060 Polyallomer substrate and smooth aluminum skins 0.021” thick minimum. The entire sandwich shall be bonded under heat and pressure with permanently elastic neoprene contact adhesive.
1. Panel Thickness: 1 inch or 2 inch as indicated on drawings.
 2. Color: PVDF/Kynar 500 Architect to select from manufacturers standard colors
 3. Interior Finish: same as face sheet.
 4. Manufacturer: Subject to compliance with requirements, provide Laminators Inc. “Thermo Lite” System or approved equal.
- C. Brackets and Reinforcements: Manufacturer’s standard high-strength aluminum units.
1. Brackets not exposed to weather or abrasion may be hot-dip galvanized steel complying with ASTM A 386.
 2. Provide non-staining, nonferrous shims for installation and alignment of curtain wall work.
- D. Fasteners and Accessories: Provide manufacturer’s standard non-corrosive fasteners and accessories compatible with materials used in the framing system and with exposed portions.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 Glazing Tape: Tremco #440; Shore A hardness of 10 at installation and not exceeding 20 upon aging.

2.6 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, black, and of profile and hardness required to maintain watertight seal:
1. Silicone, ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. Silicone.

2.7 GLAZING SEALANTS

- A. Sealant for Glazing: Meet requirements for materials and workmanship specified under Division 7 Section "Joint Sealants."
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene or EPDM 70 to 90 Shore A Hardness as recommended by manufacturer; certified non-staining and compatible with sealant. Use EPDM for units set with silicone glazing sealant.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges and corners.
- C. Glazing Contractor, Glass Fabricator and Glass Manufacturer shall determine which areas require heat strengthening. The glazing contractor shall include in his bid and shall install heat strengthened glass where it is required by manufacturer and/or fabricator.

2.10 GLASS SCHEDULE

A. Schedule of Glass Types:

- GL-1 Annealed Monolithic Glass:
Tint: Clear
Thickness: 1/4"
- GL-2 Tempered Monolithic Glass:
Tint: Clear
Thickness: 1/4"
- GL-3 Laminated Glass consisting of:
1/8" heat strengthened glass; clear
PVB interlayer; clear
1/8" heat strengthened glass; clear.
- GL-4 Translucent Laminated Glass consisting of:
1/8" float glass; clear
Interlayer: 0.030 PVB; white hue
1/8" float glass; clear.
- GL-5 Wire Glass:
1/4" polished wired glass with 1 (M1) (Diamond) pattern.
1/4" polished wired glass with 2 (M2) (Square) pattern.
- GL-6a 20-minute fire rated glass
For use in 20 minute rated doors only. Basis of design is Superlite I as manufactured by SAFTI First, a division of O'Keeffe's Inc., (888) 653-3333/(415) 822-5222 fax. Or approved equals.
- GL-6b 45-minute fire rated glass
For use in 45 minute door and window applications. Basis of design is Superlite II-XL-45 as manufactured by SAFTI First, a division of O'Keeffe's Inc. (888) 653-3333/(415) 822-5222 fax. Or approved equals.
- GL-6c 60 & 90 minute fire rated door glazing
For use in 60 & 90 minute door applications. Must comply with CPSC Category II. Nominal 1/4" thick polished ceramic glazing with impact film applied to one side. Basis of design is Superlite CSP as manufactured by SAFTI First, a division of O'Keeffe's Inc. (888)653-3333/(415)822-5222 fax. Or approved equal.
- GL-6d 60, 90 or 120 minute fire rated glass
For use in 60& 90 wall/window applications or 120 minute wall/window applications. Must comply with ASTM E-119 requirements as a barrier to radiant heat. Basis of design is Superlite II-XL as manufactured by SAFTI First, a division of O'Keeffe's Inc. (888) 653-3333/(415) 822-5222 fax. For use in GPX radiant heat barrier frames only. Or approved equals.
- GL-10 Annealed Insulating Glass consisting of:
Exterior Lite: 1/4"
Tint: Gray
Airspace: 1/2"
Interior Lite: 1/4"
Tint: Clear
Low-E Coating: #2 Surface.

- GL-11 Tempered Insulating Glass consisting of:
Exterior Lite: 1/4"
Tint: Gray
Airspace: 1/2"
Interior Lite: 1/4"
Tint: Clear
Low-E Coating: #2 Surface.
- GL-12 Tempered Insulating Translucent Glass consisting of:
Exterior Lite: 1/4"
Tint: Gray
Airspace: 1/2"
Interior Lite: 1/4"
Tint: Clear
Low-E Coating: #2 Surface.
Acid Etch - Velour: #3 Surface.
- GL-13 Laminated Metal Panel
Thickness: 1/4"
Color: To be selected from manufacturer's standard colors
- GL-14 Insulated Metal Panel
Thickness: 2"
Color: To be selected from manufacturer's standard colors

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

1. Install glass in accordance with recommendations outlined in "Glazing Manual" and "Glazing Sealing Systems Manual" prepared by Flat Glass Marketing Association.
 - B. Interior glazing shall be dryset with black glazing tape.
 - C. Exterior glazing at entrance doors, sidelights, transoms, window wall frames, and similar members shall be installed with dryset gasket glazing.
 - D. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
 - E. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
 - F. Apply primers to joint surfaces where required for adhesion of sealants.
 - G. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
 - H. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
 - I. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:
 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
 - J. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
 - K. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- 3.4 TAPE GLAZING
- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
 - B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
 - C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
 - D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 - E. Do not remove release paper from tape until just before each glazing unit is installed.

- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

****END OF SECTION****

GYPSUM WALLBOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Tile backing panels.
 - 3. Non-load-bearing steel framing.
- B. Related Sections include the following:
 - 1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing.
 - 2. Division 06 Section "Rough Carpentry" for wood framing and furring, exterior gypsum sheathing, and air infiltration barriers.
 - 3. Division 07 Section "Building Insulation" for insulation and vapor retarders installed in gypsum board assemblies.
 - 4. Division 07 Section "Interior/Exterior Finish System" for interior/exterior finish system.
 - 5. Division 09 Section "Painting" for painting.

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SYSTEM DESCRIPTION

- A. In order to be acceptable, the appearance of all exposed wallboard surfaces in finished locations, after painting, shall be equivalent, in the judgment of the Architect, to the appearance of painted putty coat plaster surfaces and as follows:
 - 1. The finish shall be equal to a Level 4 Finish as described in the current edition of the "Gypsum Construction Handbook" of the United States Gypsum Company.
- B. Structural performance of fire rated shaft-wall assemblies:
 - 1. Provide gypsum board shaft-wall assemblies capable of withstanding the full air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.

2. Provide gypsum board shaft-wall assemblies for horizontal duct enclosures capable of spanning distances indicated within deflection limits indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Lay-out drawings indicating proposed location of all control joints in metal-framed gypsum board partitions, walls, ceilings, bulkheads, fasciae and soffits. Coordination drawings for this purpose may be annotated copies of Construction Documents architectural floor plans, reflected ceiling plans and interior elevations. Submit prior to commencement of framing installation.

1.6 QUALITY ASSURANCE

- A. Comply with the provisions and recommendations of the United States Gypsum Company - "Gypsum Construction Handbook" (current edition) except where otherwise specified.
- B. Single-Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.
- C. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings and fire rated shaft-wall assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory," GA-600, "Fire Resistance Design Manual," or of other testing agency acceptable to authorities having jurisdiction.
- D. Sound Transmission Characteristics: For gypsum board assemblies and fire rated shaft-wall assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.
- C. Handle gypsum boards to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Minimum Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40°F (4°C). For adhesive attachment and finishing of gypsum board maintain not less than 50°F (10°C) for 48 hours prior to application and continuously thereafter until drying is complete.

- C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

1.9 SCAFFOLDING

- A. Provide necessary scaffolding and staging required for proper execution of wallboard work.
- B. Allow access and use of scaffolding by other trades whose work must be coordinated with wallboard work at no additional cost or back-charge and during regular working hours.

1.10 COORDINATION

- A. Make detailed inspection of all areas and surfaces to be covered.
- B. Verify dimensions, details, partition schedule and relationship to other work.
- C. Observe benchmarks and thickness of materials. Where diffusers or other accessories are mis-located notify installing trade with copy to the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 STEEL PARTITION AND SOFFIT FRAMING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Framing and Furring:
 - a. ClarkDietrich Building Systems.
 - b. Marino\Ware.
 - c. Steel Stud Solutions, LLC.
 - d. MBA Metal Framing.
- B. Components, General: As follows:
 - 1. Comply with ASTM C 754 for conditions indicated.
 - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
- C. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0454 inch (1.15 mm).
 - 2. Depth: As indicated.

- D. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
 - 2. Depth: As indicated.
- G. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical, with face attached to single flange by a slotted leg (web).
 - a. Product: U.S. Gypsum No. RC-1 or equal.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
- I. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Framing and Furring:
 - a. Clark Steel Framing Systems.
 - b. Dale Industries, Inc. - Dale/Incor.
 - c. Dietrich Industries, Inc.
 - d. National Gypsum Company.
 - e. Unimast, Inc.
 - f. Western Metal Lath & Steel Framing Systems.
- B. Components, General: Comply with ASTM C 754 for conditions indicated.
- C. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- D. Hanger Attachments to Concrete: As follows:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
 - a. Type: Cast-in-place anchor, designed for attachment to concrete forms, postinstalled, chemical anchor, or postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
- E. Hangers: As follows:
1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.
- F. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (1.37 mm), a minimum 1/2-inch- (12.7-mm-) wide flange, with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
1. Depth: Minimum 2 inches (50.8 mm) unless otherwise indicated.
- G. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
 - a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
 2. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.

2.4 WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: Gypsum core wall panel surfaced with a natural-finish face paper on front and a liner paper on back. Comply with ASTM C36 and the following:
1. Type X:
 - a. Thickness: 5/8 inch (15.9 mm).
 - b. Long Edges: Tapered.
 - c. Location: As indicated and where required for fire-resistance-rated assembly.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed., ProRoc products.
 - b. Georgia-Pacific Corp., ToughRock Gypsum Board products.
 - c. National Gypsum Company, Gold Bond Brand products.
 - d. United States Gypsum Co., Sheetrock Brand Gypsum products.

2.5 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

- B. Cementitious Backer Units (Cement Board): ANSI A118.9.
 - 1. Thickness: As indicated.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. National Gypsum Co., PermaBase Cement Board.
 - b. United States Gypsum Co., Durock Cement Board

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - 1) Product: U.S. Gypsum No. 103 Dur-A-Bead or equal.
 - b. LC-Bead (Casing Bead): J-shaped; exposed long flange receives joint compound; use at exposed panel edges and where indicated.
 - 1) Product: U.S. Gypsum No. 200-A Metal Trim or equal.
 - c. L-Bead (Casing Bead): L-shaped; exposed long leg receives joint compound; use where indicated.
 - 1) Product: U.S. Gypsum No. 200-B Metal Trim or equal.
 - d. Control Joint: Use at control joint locations in walls, ceilings, bulkheads, fasciae and soffits:
 - e.
 - 1) Product: U.S. Gypsum No. 093 Control Joint, or equal.
 - 2) Back to back casing beads may be used in lieu of prefabricated control joint trim. Provide backer and sealant to finish opening between beads as with materials appropriate to conditions of installation.
 - f. Curved-Edge Cornerbead: With notched or flexible flanges for use at curved openings.
 - 1) Product: U.S. Gypsum Sheetrock Flexible Metal Corner Tape or equal.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound or drying-type, all-purpose compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by manufacturer.

2.8 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.
- B. Products: Subject to compliance with requirements, provide the following:
 1. Acoustical Sealant for Concealed Joints:
 - a. Tremco, Inc.; Tremco Acoustical Sealant.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate and for adhering second layer of wallboard to first layer.
 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to cold formed metal framing and steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Isolation Strip at Exterior Walls:
 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

- E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - 2. Density: 2.5 pounds per cubic foot.
 - 3. Thickness: 3 inches unless indicated otherwise on the drawings
 - 4. Products: Subject to compliance with requirements, provide the following:
 - a. Thermafiber Sound Attenuation Fire Blankets as manufactured by United States Gypsum Co.
- F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."
- G. Polyethylene Vapor Retarder: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Control Joint Layout: Prior to commencement of framing installation submit coordination drawings indicating proposed control joint locations in metal-framed gypsum board partitions, walls, ceilings, bulkheads, fasciae and soffits, for review and acceptance of Architect.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deep-leg deflection track where indicated.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
- E. General requirements and locations of control joints in metal-framed gypsum board construction:
 - 1. General: Comply with requirements of ASTM C840, and as noted below:
 - 2. Control joints shall be constructed with manufactured control joint trim, or field fabricated from materials as specified.
 - 3. Control joints will be installed where a partition, wall, or ceiling traverses and construction joint (expansion, or building control element) in the base building structure.
 - 4. Control joints will be installed where a wall or partition extends in an uninterrupted straight plane exceeding 30 linear feet. Door and/or window frames that extend full height of partitions will be considered equivalent to control joint construction.
 - 5. Control joints in interior ceilings, bulkheads, fasciae and soffits will be installed so that linear dimensions between control joints do not exceed 30 linear feet and total area between control joints does not exceed 900 square feet. Control joints will be installed to isolate wings of "L", "U: and "T" shaped ceiling and soffit areas.
 - 6. A control joint will be installed where ceiling, bulkhead, fascia and soffit framing members change direction.
 - 7. Provide appropriate backing material, fire-safing insulation, and sealant for control joints installed in acoustical or fire-rated construction, as required to maintain fire-rating and/or acoustical separation.
- F. All mechanical heating and cooling system components shall be independently supported; not supported by gypsum board framing system.
- G. Provide gypsum panel bulkheads and closures where ducts penetrate fire separations.

3.4 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
 - 1. Where studs are installed directly against exterior walls, install foam-gasket isolation strip between studs and wall.
 - 2. Anchor tracks 24 inches o.c. with not less than two fasteners per section.
 - a. Review electrical conduit layout in slab, avoid penetration of conduits running directly below walls.
 - 3. Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.
 - 4. Allow for differential movement between floors and at roofs by use of nested runners unless otherwise noted.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - 1. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 - 2. Metal studs which cannot extend full height to structure above, due to interference with ductwork and the like, shall be tied to cross stiffening, or diagonal bracing to structure above.
 - 3. Terminate partition framing at suspended ceilings where indicated.
 - 4. Interrupt metal framing (including top and bottom tracks) with a 1/2-inch gap at all control joint locations. Provide back to back studs and or framing for each control joint flange. Provide appropriate backing material, fire-safing insulation, and sealant for control joints installed in acoustical or fire-rated construction, as required to maintain fire-rating and/or acoustical separation.
- D. Install supplementary framing, blocking, backing plates and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work.
- E. Install steel studs and furring at the following spacings:
 - 1. Single-Layer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
 - 2. Multilayer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
 - 3. Cementitious Backer Units: 16 inches (406 mm) o.c., unless otherwise indicated.

- F. Install horizontal stiffeners in stud system, spaced (vertical distance) not more than 4'-6" o.c. Weld at each intersection.
- G. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- H. Acoustical Partition:
 - 1. Typical Partition: Steel channel studs with one or two layers of wallboard each side, with or without blanket insulation between the studs.
 - 2. Lay all runners in mastic or caulk between wallboard and floor.
 - 3. Caulk all top and bottom joints between the wallboard and structure.
 - 4. Tape other joints and spackle partition thoroughly airtight.
- I. Sound Insulation (where indicated): Install in accordance with manufacturer's recommendations.
- J. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install two studs at each jamb, unless otherwise indicated.
 - 2. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- K. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- L. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.
- M. Polyethylene Vapor Retarder: Where indicated install to comply with requirements specified in Division 7 Section "Building Insulation."

3.5 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. All ceiling construction shall be fully "unrestrained". Interrupt main runners, furring, or wallboard ceilings at walls of all full sized rooms as required to accommodate building movement. Use appropriate trim pieces to accomplish the work.

1. Cut furring, reinforce, support, and fit for electric outlet boxes, recessed fixtures, grilles and similar items.
 2. Provide allowance for anticipated building movement between floors and ceilings or soffits.
- B. Suspend ceiling hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - a. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - b. Do not attach hangers to steel deck tabs.
 - c. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - d. Do not connect or suspend steel framing from ducts, pipes, or conduit.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers 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.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
- C. Tie carrying channels to hangers with single (only) wrap of wire to avoid lifting channel.
- D. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member and transversely between parallel members.
- E. Wire-tie furring channels to supports, as required to comply with requirements for assemblies indicated.
1. Saddle tie furring channels to carrying channels with double strand tie wires.
 2. Screw furring to wood framing.
- F. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
1. Hangers: 48 inches (1219 mm) o.c.
 2. Carrying Channels (Main Runners): 48 inches (1219 mm o.c.
 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
- 3.6 APPLYING AND FINISHING PANELS, GENERAL
- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

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- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels.
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. Hold gypsum panels free from all surfaces subject to condensation or moisture.
- M. Floating Construction: Where feasible, including where recommended in writing by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.
- N. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and

closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

O. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

P. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.7 PANEL APPLICATION METHODS

A. General:

1. Plenum wall, ceiling drops, skirts or baffles that are beyond reach of user or occupant are to be constructed to meet L/120 deflection criteria.
2. Partitions, ceiling drops, baffles or other assemblies within user or occupant contact or with painted or vinyl finishes or that some vibration or movement is not detrimental to perceived structural integrity shall be constructed to meet L/240 deflection criteria.
3. Partitions, or assemblies where finish is a rigid veneer, such as plaster, skim coat, tile or stone work or mounted mirror or any use that would be compromised by vibration or deflection shall be constructed to meet L/360 deflection criteria.
4. Do not proceed with work until temperature and humidity of building meet requirements of manufacturer's standard specifications.
5. Fastening system shall be power driven drywall screws. Where hand driven fasteners are used, double nailing will be required.
6. Set all nails and screws to slightly dimple, but not break surface of board. Space nails 6 to 8 inches, 3/8 inch from edges, staggered at joints; double spacing for screws.
7. Repair areas scarified or otherwise damaged by cutting out damaged areas, back blocking set with adhesive, and patching with patching plaster.
8. Grout anchors for door frames. Jamb board into door frame to provide rigidity. Full grout frames at label doors, shaftwall, and elsewhere as indicated.
9. Metal studs with finish one side are to receive stiffener channels at no more than 4'-6" maximum spacing.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

- C. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- D. Tile Backing Panels:
 - 1. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
 - a. Where indicated install standard gypsum wallboard panels to produce a flat surface at tiled areas not subject to wetting.
 - 2. Examine framing; verify that framing and furring members to receive cement board has a maximum spacing of 16" o.c. and is minimum 20 gauge with a maximum deflection of L/360.
 - 3. Install cement board in accordance with manufacturer's instructions.
 - a. Install cement board with rough side out.
 - b. Use maximum lengths possible to minimize number of joints.
 - 4. Attach cement board to framing with screws spaced 8" o. c. at perimeter where there are framing supports, and 8" o. c. along intermediate framing in field.
 - a. Drive fasteners to bear tight against and flush with surface of cement board. Do not countersink. Locate fasteners minimum 3/8" from edges and ends of cement board.
 - 5. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations specified and per reviewed Coordination Drawings, subject to Architect's approval. Install control joint trim in accordance with manufacturer's recommendations.
- C. All aluminum in contact with joint compound shall have contact faces treated with zinc chromate primer.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 - 1. Apply perforated tape and compound at all joints, at inside corner and as required to conceal all fasteners and finish off all trim. Protect outside corners with corner beads.
 - 2. Finished appearance shall be perfectly smooth so that, after painting, there shall be no evidence of taping or patching. Areas where the location of joints or fasteners may be determined by visual inspection due to bulges, irregularities in surface of variations in texture, will be considered defective.

3. If dry-out or over-sanding of finish coat of compound leaves surface requiring special treatment or sealing, provide such sealer or treatment and leave entire surface acceptable to the finishing trades as specified under Division 9 Section "Painting."
 4. Repair all nail pops, wrinkles, buckles and other defects occurring during the Guarantee period and make good all damage to other work resulting from such repairs.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- 3.10 ACOUSTICAL BULKHEADS IN PLENUM SPACE
- A. Provide acoustical separation by bulkhead in ceiling plenum space where indicated.
- B. Bulkhead: Tight assembly of screw studs and wallboard with all cracks sealed or gasketed. Bulkheads between adjacent rooms require wallboard on one side only (where so indicated.).
- C. Coordinate with acoustical ceiling work.
- D. Where bulkheads are built to enclose and shield noisy ducts, no part of the bulkhead structure may touch the duct.
- 3.11 PATCHING AND REPAIRS
- A. Prior to start of painting or installation of wall covering, neatly and accurately patch and repair all damaged wallboard to match finish of adjoining work. Cut out cracks, damaged areas, blemished, defective portions and re-work to match adjacent area.
- B. Apply chemical treatment where required to remedy defects.
- C. After sizing and seal coats have been applied, as specified under Division 9 Section "Painting," patch and repair any hair cracks or fine cracks which become visible, as necessary to render finish painting free from visible cracks.
- 3.12 CLEAN UP
- A. Upon completion of the work, in each area, brush all surfaces clean including floors, ledges and other areas carrying droppings or debris resulting from the work.
- B. Upon completion of work in any area or as often as directed, remove from the premises and legally dispose of all surplus materials, and construction debris.
- C. Do not bury lime or gypsum materials on the site.

END OF SECTION

TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of 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. Porcelain Tile
 - 2. Grout and Setting Materials
 - 3. Synthetic Thresholds
 - 4. Anti-Fracture Membrane
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
 - 2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Division 9 Section "Gypsum Wallboard Assemblies" for cementitious backer units installed as part of gypsum wallboard systems.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. 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.
- D. 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.
 - 3. Synthetic thresholds in 6-inch lengths.

1.4 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.

1.5 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.

1.6 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°F (10°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.
- D. Do not install mortar, set or grout tile exterior when inclement weather conditions are expected within 48 hours after work is completed unless properly protected.
- E. Protection: Protect adjacent work surfaces during tile work until mortar and grout has set.

1.7 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

2.1 MANUFACTURERS

A. Tile: Subject to compliance with requirements, provide products as follows:

1. CT1:
Virginia Tile
Porcelain Tile
Crossville
Argent Porcelain Stone
Thickness: 9.5 mm
Nominal Size: 4" x 12"
Finish: UPS
Grout Joint: 4.5 mm
Color: A1415 Memphis Blues

Bullnose:
Single Bullnose
Size: 4" x 12"

Note: This size comes from the "Get Planked" collection and may result in extended lead times. Consult Manufacturer's Representative for lead times.

Manufacturer's Representative: Kathleen Somervell (248)467-4362

2. CT2:
Virginia Tile
Porcelain Tile
Crossville
Argent Porcelain Stone
Thickness: 9.5 mm
Nominal Size: 6" x 24"
Finish: UPS
Grout Joint: 4.5 mm

Color: A1420 On The Rocks

Note: This size comes from the "Get Planked" collection and may result in extended lead times. Consult Manufacturer's Representative for lead times.

Manufacturer's Representative: Kathleen Somervell (248)467-4362

3. CT3:
Virginia Tile
Porcelain Tile
Crossville
Argent Porcelain Stone
Thickness: 9.5 mm
Nominal Size: 6" x 6"
Finish: UPS
Grout Joint: 4.5 mm

CT3A: A1401 Winter Garden
CT3B: A1420 On The Rocks

Manufacturer's Representative: Kathleen Somervell (248)467-4362

- 4. CT4
Virginia Tile
Porcelain Tile
Crossville
Argent Porcelain Stone
Thickness: 9.5 mm
Nominal Size: 6" x 12"
Finish: UPS
Grout Joint: 4.5 mm
Color: A1420 On The Rocks

Base:
Cove Base (Universal, Flat Top)
Size: 6" x 12"

Manufacturer's Representative: Kathleen Somervell (248)467-4362

2.2 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 selections made by Architect from manufacturer's full range of colors, textures, and patterns as indicated for each product.
 - 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- 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. 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.

2.3 TRIM UNITS:

- A. 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 selected by Architect from manufacturer's standard shapes, and as necessary for a complete installation.

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to ½ inch (12.7 mm) or less, and finish bevel to match face of threshold.
- B. Synthetic (Solid Polymer) Thresholds: Made from homogenous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or 6, without precoated finish.
 1. Manufacturers: E. I. DuPont De Nemours & Co., Corian Surfaces.
 - a. Color: Architect shall select one (1) color from manufacturer's full range, including Price Group D.

2.5 CRACK ISOLATION MATERIALS

- A. Crack Isolation Membrane: ANSI A118.12, composition as follows:
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Laticrete: Blue 92 Anti-Fracture Membrane.
 - b. MAPEI Corporation; Mapelastic AquaDefense Waterproofing and Crack-Isolation Membrane.
 - c. TEC; a subsidiary of H. B. Fuller Company; HydraFlex Waterproofing Crack Isolation Membrane.
 - d. Custom Building Products: RedGard Waterproofing and Crack Prevention Membrane or 9240 Waterproofing and Anti-Fracture Membrane.
 2. Location: Full membrane at all locations unless indicated otherwise.

2.6 SETTING MATERIALS

- A. Polymer Enhanced Mortars: ANSI A118.4/ANSI A118.15, composition as follows:
 1. For TCNA defintied Large Format Tiles, provide medium bed mortar.
 2. For Glass Tiles, provide white mortar.
 3. Provide product that is approved by manufacturer for application thickness of 5/8".

2.7 GROUTING MATERIALS

- A. Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy: ANSI A118.3.
 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.

2. Epoxy Grout:

- a. Epoxy Grout: Epoxy Grout shall be as manufactured by one of the following:
 - 1) MAPEI Corporation, "Kerapoxy"
 - 2) Bostik Findley, Inc. "Hydroment Color-Poxy"
 - 3) TEC Specialty Products Inc. "AccuColor EFX"
 - 4) Custom Building Products "CEG Lite"
- b. Location: All Toilet Rooms
- c. Colors: Architect shall select two (2) colors from manufacturer's full line.

2.8 MISCELLANEOUS MATERIALS

- A. Metal Edge Strips: Zinc alloy or stainless steel terrazzo strips, 1/8-inch wide at top edge with integral provision for anchorage to mortar bed or substrate unless otherwise indicated.

2.9 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

3.1 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.

3.2 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.

3.3 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. TCNA Installation Guidelines: TCNA "Handbook for Ceramic, Glass, and Stone Tile Installation"; comply with TCNA installation methods indicated.
- C. Install crack isolation membrane over entire surface to comply with manufacturer's written instructions to produce a membrane of uniform thickness bonded securely to substrate.
- D. 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.
- E. 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.
- F. 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.
- G. Lay out tile wainscots to dimensions indicated.
- H. 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.
- I. Grout tile to comply with the requirements of the following installation standards:
 - 1. For ceramic tile grouts (and latex-portland cement grouts), comply with ANSI A108.10.
 - 2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 FLOOR INSTALLATION METHODS

- A. Ceramic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction, and grout types:
 - 1. Polymer Enhanced Mortars: ANSI A108.5.
 - a. Concrete Subfloors, Interior: TCNA F112, F113 and 125A as indicated on Drawings.
 - 1) Install crack isolation membrane over entire surface at all locations unless indicated otherwise.
 - b. Grout: High Performance Latex-Portland Cement.

- 1) Provide epoxy grout where noted in specifications and where indicated on Drawings.
- B. Thresholds: Install synthetic thresholds at locations indicated; set in same type of setting bed as abutting field tile unless otherwise indicated.
 1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.
- C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane over entire surface to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

3.6 WALL TILE INSTALLATION METHODS

- A. Install types of tile designated for wall application to comply with requirements indicated below for setting-bed methods, TCNA installation methods related to subsurface wall conditions, and grout types:
 1. Polymer Enhanced Mortars: ANSI A108.5.
 - a. Masonry, Interior: TCNA W202.
 - b. Cementitious Backer Units, Interior: TCNA W244.
 - c. Grout: Latex-portland cement.

- 1) Provide epoxy grout where noted in specifications.

3.7 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.

SECTION 093000
TILE

1. 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.
 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

****END OF SECTION****

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of acoustical ceilings.
 - 1. Acoustical panel ceilings installed with exposed suspension systems.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 9 Section "Gypsum Wallboard Assemblies" for gypsum board substrate for adhered acoustical tile.
 - 2. Division 15 for grilles, registers, and diffusers and sprinkler heads in acoustical ceilings.
 - 3. Division 16 for lighting fixtures in acoustical ceilings.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual acoustical units or sections of units showing full range of colors, textures, and patterns available for each type of unit indicated.
- D. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.
 - 1. 6-inch-square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.
- E. 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, and other information specified.
- F. Product test reports from qualified independent testing laboratory that are based on its testing of current products for compliance of acoustical ceiling systems and components with requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.
- B. Fire-Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire-performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 - 2. Fire-Resistance Ratings: As indicated by reference to design designations in UL "Fire Resistance Directory," for types of assemblies in which acoustical ceilings function as a fire-protective membrane and tested per ASTM E 119.
 - a. Protect lighting fixtures and air ducts to comply with requirements indicated for rated assembly.
- C. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- E. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.
1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
 2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS

- A. Manufacturer: Subject to compliance with requirements provide products as follows:
1. ACT1 USG Interiors
 Fissured
 Item No. : 131
 Size: 24" x 24" x 3/4"
 Edge: SQ
 Color: White
 Or Equal By: Armstrong, CertainTeed

2.2 METAL SUSPENSION SYSTEMS

- A. Suspension systems shall conform to ASTM C-635 for "intermediate duty" classification, except that where quantity or weight of ceiling fixtures would create deflection of greater than 1/360 of the span length, "heavy duty" system shall be used or ceiling grid shall be reinforced in a manner to maintain deflection of less than 1/360 of the span length. The General and Supplementary Conditions shall take precedence over Section 6 (Inspection) of ASTM C-635. All recessed light fixtures shall be supported by main runners on not less than two opposite sides.
1. Exposed portions shall receive a factory applied matte white baked enamel finish.
- B. Manufacturer: Subject to compliance with requirements provide products as follows:
1. Grid at ACT1:
 - a. USG Interiors
Donn DX Suspension System with 15/16" Exposed Face
Color: White
Or Equal By: Armstrong, CertainTeed
- C. Edge trim system: Subject to compliance with requirements provide products as follows:

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."
 - 1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.
- B. Arrange acoustical units and orient directionally patterned units (if any) in a manner shown by reflected ceiling plans.
- C. Suspend ceiling hangers from building structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the 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.
 - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms; furnish cast-in-place hanger inserts that extend through forms.
 - 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 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.
- D. Install edge moldings of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.
1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
 2. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.
- E. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
1. Install hold-down clips in areas indicated and in areas where required by governing regulations or for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.
- 3.4 CLEANING
- A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

****END OF SECTION****

CARPET TILE

PART 1 - GENERAL

1.1 RELATED SECTIONS

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

1.2 SUMMARY

- A. This Section includes carpet tile, installation, resilient wall base, and accessories installed with carpet.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Submit manufacturer's technical product data for each type of carpet tile specified to verify compliance with specifications.
- C. Shop Drawings: Provide shop drawings showing layout and placement of cut tiles. Indicate pile or pattern direction, start points, and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tile. Show installation details at special conditions.
- D. SAMPLES:
 - 1. For verification purposes of each carpet tile specified.
 - 2. For verification purposes of any edge strips to be used.

1.4 QUALITY ASSURANCE

- A. Carpet Tile Surface Burning Characteristics: Provide written data, if requested, for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet tile with appropriate markings of applicable testing and inspecting organization.
 - 1. Test Method: DOC FF 1-70. Pill Test
 - 2. Rating: Pass.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.
- B. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 68 deg F (20 deg C) at least three days prior to and during installation in area where materials are stored.

1.6 PROJECT CONDITIONS

- A. Substrate Conditions: No condensation on underside of 4-foot by 4-foot polyethylene sheet within 48 hours, fully taped at perimeter to substrate.
- B. Substrate Conditions: pH of 9 or less when substrate wetted with potable water and pHydration paper applied.

1.7 CONTRACTOR TURNOVER REQUIREMENTS

- A. Warranty: Provide copies of manufacturer's warranty for each product used.
- B. Maintenance: Provide maintenance data consisting of manufacturer's printed instructions for each carpet tile used. Include methods and frequency of recommended cleaning as well as any precautions.
- C. Replacement Materials: Before installation begins, provide to Owner a quantity of material in full size units equal to 2 percent of the amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide the following Carpet Tile:
 - 1. CPT1
Manufacturer: Shaw Contract Group
Style: Chroma Tile 59583
Construction: Multi-Level Pattern Loop
Fiber: Solution Q Extreme Nylon
Dye Method: 100% Solution Dyed
Gauge: 1/12
Total Thickness: 0.254 inches
Size: 24" x 24"
Backing: Ecoworx Tile
Installation Method: Random
Color: Infinite 83515
- B. Resilient Wall Base: Subject to compliance with requirements provide products as follows:
 - 1. RB1 Provide one of the following:
 - a. Johnsonite
Rubber Wall Base
Height: 4"
Color: Architect shall select one (1) color from manufacturer's full line.
 - b. Roppe
Rubber Wall Base
Height: 4"
Color: Architect shall select one (1) color from manufacturer's full line.

2.2 ACCESSORIES

- A. Carpet Edge Guard: Extruded or molded heavy-duty vinyl or rubber of size and profile indicated; minimum 2-inch-wide anchorage flange; manufacturer's standard colors.
- B. Rubber Wall Base: Provide rubber base complying with FS SS-W-40, Type I, with matching end stops and preformed or molded corner units, and as follows:
 - 1. Height: 4".
 - 2. Thickness: 1/8" gage.
 - 3. Style: Standard top set cove.
 - 4. Finish: Matte.
- C. Resilient Edge Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color to match flooring, or as selected by Architect from standard colors available; not less than 1" wide.
- D. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. If substrate is new concrete, clear away debris and scrape up cementitious deposits from concrete surfaces to receive carpet tile; apply sealer to prevent dusting.
- B. If the substrate is existing concrete, patch holes and level to a smooth surface. If previous finish was chemically stripped, reseal concrete. Seal powdery or porous surfaces with sealer recommended by carpet tile manufacturer.
- C. If the substrate is wood, patch holes and cracks. Sand to level. Remove wax. Seal surface with sealer recommended by carpet tile manufacturer.
- D. If the substrate is resilient flooring, replace missing pieces of existing resilient flooring or patch to level. Cut out peaked sheet goods seams and fill with latex underlayment.
- E. If the substrate is terrazzo, remove chemical finish on terrazzo; patch grout lines and cracks to level with latex underlayment.

3.2 INSTALLATION

- A. Comply with manufacturer's recommendations for a "Glue down" installation of carpet tile; maintain uniformity of carpet direction and lay of pile, unless otherwise indicated.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Extend carpet tile under removable flanges and furnishings and into alcoves and closets of each space.
- D. Install carpet edge guard where edge of carpet tile is exposed; anchor guards to substrate.

- E. Install with pattern parallel to walls and borders. Perimeter modules shall be half-size or larger.

3.3 INSTALLATION OF ACCESSORIES:

- A. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practical, with preformed outside corner units, and fabricated with mitered or coped inside corners. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
 - 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.
- B. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.4 CLEANING

- A. Remove any tape or adhesive from carpet tile surface with manufacturer's recommended cleaning agent.
- B. Remove and dispose of debris and unusable scraps. Vacuum using commercial machine with face-beater element. Remove soil. Replace carpet tiles where soil cannot be removed. Remove protruding face yarn.
- C. Vacuum carpet tile.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure carpet tile is not damaged or deteriorated at time of Substantial Completion.

****END OF SECTION****

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes, labor, materials and equipment for Painting and Finishing.
- B. The following sections contain requirements that relate to this Section:
 - 1. Division 06 Section "Interior Architectural Woodwork" for factory finished millwork.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit 8-1/2 x 11 color downs on heavy paper to match Architect's color chips for each color and type of paint specified for Architect's approval.
 - a. Architect will furnish a schedule after beginning of construction. The schedule will include color chips for matching.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Material Certificates: For scrub resistance and washability, signed by manufacturers.

1.4 QUALITY ASSURANCE

- A. Architect has the option of requesting test patches in place for Architect's approval of final color and finish.
 - 1. Notify Architect 48 hours in advance of the time the test patches will be ready for inspection.
- B. Manufacturer shall certify that tests have been performed on semi-gloss wall finish and others as selected by the Architect. Acceptance of materials is conditional upon demonstration of washability and abrasion resistance of test patches. Testing shall include the following:
 - 1. Scrub resistance per ASTM D2486-79: Value as specified in approved finish schedule but not less than 1200.
 - 2. Washability per ASTM D3450-80: Value as specified in approved finish schedule but not less than 80% for sponge and 90% for brush.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.
 - a. Do not store oil or paint soaked rags inside the building.
 - 3. Do not store materials in any room containing a direct-fired heating unit.
- B. Mix and thin paints in strict accordance with recommendations of the manufacturer.
 - 1. Mix paints only in areas designated, and provided proper protection for walls and floors.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply interior paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce manufacturer and product lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.3 COLORS

- A. The Architect has the option of accenting certain building elements different colors; (i.e.: doors, frames, columns, ceilings, walls) to be defined in a Schedule.
- B. The Architect reserves the right to select colors from manufacturer's standard or premium price groups, including deep tone colors for both interior and exterior products.

- C. Furnish an equal product by the same manufacturer only in those instances where a deep tone color specified by the Architect is not available in the specified product. This is subject to Architect's approval.
- D. Tinted primer shall be used whenever deep tone colors are specified.

2.4 EXTERIOR FINISHES

- A. Ferrous Metals (i.e. doors, railings, fences, lintels, etc.):
 - 1. First Coat: (If flash rusting occurs, use two coats)
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
 - 2. Second and Third Coats:
 - a. Sherwin Williams: DTM Acrylic Gloss Coating (Water Reducible), B66-100
- B. Concrete, Masonry, Concrete Block, and Stucco - Sealer:
 - 1. First and Second Coats: Apply per manufacturer's recommendations.
 - a. United Coatings Inc; Canyon Tone Stain. Custom colored.
 - b. No substitutions shall be accepted.
- C. Cementitious Materials:
 - 1. Preparation: Add a prime coat if recommended by manufacturer (for a total of 3 coats).
 - 2. Two Coats:
 - a. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series
- D. Composition Board, Hardboard, Fiberboard:
 - 1. First Coat:
 - a. Sherwin Williams: Exterior Latex Wood Primer B42W8041
 - 2. Second and Third Coats:
 - a. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series
- E. Previously Painted Cement Plaster (new cement plaster shall remain unpainted):
 - 1. First Coat:
 - a. Sherwin Williams: Exterior Latex Wood Primer B42W8041
 - 2. Second and Third Coats:
 - a. Sherwin Williams: A-100 Satin Latex House and Trim Paint, A82 Series
- F. Exterior Structural Steel exposed to view.

1. For warranty purposes, the Contractor shall insure that the specified primer in Division 5 "Structural Steel" and the intermediate and finish coats specified below are from the same manufacturer.
 - a. No coatings shall be applied until approved by the Architect and Owner's Representative.
2. Prime Coat: Refer to Division 5, "Structural Steel."
3. Intermediate Coat:
 - a. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.
4. Finish Coat:
 - a. Sherwin Williams: One (1) coat Acrolon 218 HS @ 3-6 mils DFT.

2.5 INTERIOR FINISHES

A. Plaster and Gypsum Board Ceilings and Ceiling Drops

1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
2. Second Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Latex Flat B30 Series
3. Third Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Latex Flat B30 Series

B. Plaster and Gypsum Board Walls and Columns – Non-epoxy:

1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
2. Second and Third Coats:
 - a. Sherwin Williams: ProMar 200 Zero VOC Latex Eg-Shel B20 Series

C. Plaster and Gypsum Board Walls and Columns - Epoxy:

1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600
2. Second and Third Coats:
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25

D. Existing Painted Plaster and Gypsum Board Walls and Columns - Epoxy:

1. Sample Patch: Prepare a 36" x 36" minimum test area to see if a reaction occurs between existing and new finishes prior to proceeding with the specified work. If a reaction occurs, alert Architect and propose solution(s).
 2. First Coat: Barrier Coat Primer
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600 (bare spots and patches)
 3. Second and Third Coats:
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- E. Concrete Block - Sealer:
1. First and Second Coats: Apply per manufacturer's recommendations.
 - a. United Coatings Inc; Canyon Tone Stain. Custom colored.
 - b. No substitutions shall be accepted.
- F. Masonry Block
1. First Coat: Masonry block filler at rate not to exceed 100 sq. ft. per gal.
 - a. Sherwin Williams: Pro Mar Interior/Exterior Block Filler B25W25
 2. Second and Third Coats – Non-epoxy.
 - a. Semi-Gloss Latex Enamel Finish: Two (2) Coats over filled surface with total dry film thickness not less than 3.5 mils, excluding filler coat.
 - 1) Sherwin Williams: ProMar 200 Zero VOC Latex Semi-Gloss B31 Series
 3. Second and Third Coats - Epoxy.
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- G. Existing Painted Masonry Block - Epoxy.
1. Sample Patch: Prepare a 36" x 36" minimum test area to see if a reaction occurs between existing and new finishes prior to proceeding with the specified work. If a reaction occurs, alert Architect and propose solution(s).
 2. First Coat: Barrier Coat Primer
 - a. Sherwin Williams: Loxon Masonry Primer A24W8300 (patches and bare spots)
 3. Second and Third Coats.
 - a. Sherwin Williams: Water Based Catalyzed Epoxy, B70/B60V25
- H. Ferrous, Galvanized Metals, Aluminum
1. Preparation:
 - a. See Divisions 5 and 8 for requirements for priming of ferrous metals.
 - b. Do all touch up and priming of unprimed metals in accordance with requirements of Divisions 5 and 8.

2. Apply paint in accordance with Steel Structure Painting Council Paint Application Specifications SSPC-PA1 to a dry film thickness as specified by the manufacturer.
3. First Coat - Primer:
 - a. Ferrous metal (to be used even at shop primed items except as noted in Division 5):
 - 1) Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
 - b. Galvanized metal after thorough cleaning per SSPC-SP1 with water soluble degreaser. No hydrocarbons.
 - 1) Sherwin Williams: ProCryl Universal Metal Primer B660310 Series
 - c. Aluminum:
 - 1) Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
4. Second and Third Coats:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.
- I. Galvanized Steel including galvanized decking and all steel in pool environments:
 1. For warranty purposes, the Contractor shall insure that the specified primer in Division 5 "Steel Deck" and the intermediate and finish coats specified below are from the same manufacturer.
 - a. No coatings shall be applied until approved by the Architect and Owner's Representative.
 2. Prime Coat: Refer to Division 5, "Steel Deck."
 3. Intermediate Coat:
 - a. Sherwin Williams: One (1) coat Macropoxy 646 FC @ 5-10 mils DFT.
 4. Finish Coat:
 - a. Sherwin Williams: One (1) coat Acrolon 218 HS @ 3-6 mils DFT.
- J. Painted Woodwork including any interior window sash and trim:
 1. Coordinate with "Interior Architectural Woodwork" Section to verify Scope of Work to be finished by Millwork Contractor.
 - a. First Coat:
 - 1) Sherwin Williams: Premium Wall & Wood Primer B28W8111
 - b. Second Coat:
 - 1) Sherwin Williams: ProMar 200 Interior Waterbased Acrylic-Alkyd B33W8251

K. Natural Finished Woodwork:

1. Coordinate with "Interior Architectural Woodwork" section to verify Scope of Work to be finished by Millwork Contractor.
 - a. First Step:
 - 1) Wood Filler, applied as per manufacturer's instructions
(Do not apply filler to open grained wood)
 - a) Benjamin Moore: Benwood Paste Wood Filler 238
 - b) Pratt & Lambert: Filler-Sealer
 - b. Second Step: Stain, as needed to achieve color as per Architect; applied as per manufacturer's instructions. The following products or equal as approved by Architect:
 - 1) Sherwin Williams: Wood Classic 250 VOC Stain.
 - c. Third Step: Sanding Sealer, if recommended by the manufacturer.
 - d. Fourth Step: Two (2) Finish Coats
 - 1) Sherwin Williams: Wood Classic Waterborne Polyurethane Varnish, A68 Series.

2.6 MECHANICAL

A. Apparatus, Equipment, and Equipment Supports

1. First Coat:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series
2. Second Coat:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.

B. Exposed Bare Piping, Valves, Fittings, and Hangers:

1. First Coat:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
2. Second Coat:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.

C. Exposed Insulation Piping, Valves, Fittings, and Hangers when canvas wrapped:

1. First Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Primer B28W2600

2. Second Coat:
 - a. Sherwin Williams: ProMar 200 Zero VOC Flat B30 Series.
 - D. Insulated Ductwork and Piping with Canvas Covering Inc. Hangers for any kind of ductwork.
 1. One Brush Coat:
 - a. Pittsburgh Paints: 42-7, Speedhide Interior Fire Retardant Flat Latex.
 - E. Grilles, Registers, and Diffusers
 1. First Coat:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 2. Second and Third Coats:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.
 - F. Exterior Ductwork Exposed to Weather
 1. First Coat (Heavy coat of one of the following):
 - a. Sherwin Williams: Macropoxy 646 Fast Cure, B58-600/B58V600.
 2. Second and Third Coats (allow 24 hours drying time after first coat):
 - a. Sherwin Williams: Hi-Solids Polyurethane B65-300.
- 2.7 ELECTRICAL
- A. Exterior Exposed Electrical Conduit Fittings, Boxes, and other miscellaneous exterior electrical items.
 1. First Coat - Galvanized:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 2. First Coat - Ferrous Metal:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
 3. Second and Third Coats:
 - a. Sherwin Williams: DTM Acrylic Gloss Coating (Water Reducible), B66 Series
 - B. Interior Exposed Electrical Items in areas where walls and/or ceilings are painted including electrical panels, cabinets, exposed conduit, etc.
 1. First Coat - Galvanized:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.

2. First Coat - Ferrous Metal:
 - a. Sherwin Williams: ProCryl Universal Metal Primer B66-310 Series.
3. Second and Third Coats:
 - a. Sherwin Williams: Pro Industrial Zero VOC Acrylic Semi-Gloss B66-600 Series.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Masonry (Clay and CMU): 12 percent.
 3. Wood: 15 percent.
 4. Gypsum Board: 12 percent.
 5. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION OF NEW SUBSTRATES

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.
- F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- G. Ferrous Metals, Galvanized Metal, Aluminum: Clean surfaces according to the Steel Structure Painting Council Surface Preparation Specifications: SSPC-SP1 Solvent Cleaning, SSPC-SP2 Hand Tool Cleaning, or SSPC-SP3 Power Tool Cleaning, as appropriate.
 - 1. Steel Substrates: Remove any rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 - 2. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - a. Thoroughly clean galvanized metal per SSPC-SP1 with water soluble degreaser. No hydrocarbons.
 - 3. Aluminum Substrates: Remove surface oxidation.
- H. Wood Substrates:
 - 1. Refer to Division 6 Section "Finish Carpentry and Millwork" for preparation specified under other trades.
 - 2. Countersink all nails and finish with putty or plastic wood filler. Sand smooth when dried.
 - 3. Sand surfaces that will be exposed to view, and dust off.
 - 4. Prime edges, ends, faces, undersides, and backsides of wood.
 - 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- J. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 PREPARATION OF EXISTING SUBSTRATES

- A. Preparation of Previously Painted Surfaces: Comply with requirements as specified for preparation of new substrates as well as the following:
 - 1. Scrub clean existing surfaces with a stiff brush and a solution of clean water and mild detergent.

2. Scuff sand surface to allow new finish to hold.
3. De-gloss painted surfaces in a manner appropriate to the substrate.
4. Fill cracks, holes, voids and defects, and leave a smooth surface ready for application of primer.
5. Remove loose paint and feather edges or patch as required to provide a smooth, seamless finish.
6. Prepare a 36" x 36" minimum test area to see if a reaction occurs between existing and new finishes prior to proceeding with the specified work. If a reaction occurs, alert Architect and propose solution(s).

3.4 PRIMING AND BACKPRIMING OF WOOD

- A. All wood, factory finished or otherwise, must be back-primed immediately upon delivery with interior trim primer specified for wood which is to be painted, or finish manufacturer's recommended protective pre-treatment for wood which is to have natural finish.
- B. Apply first coat to all wood scheduled to receive natural finish before material is handled at the site by other trades.
- C. Furnish sealer to other trades for touching up any bare wood caused by mortising or butting of surfaces, or any kind of assembly or installation.
- D. Avoid painting over or otherwise staining edges of wood where natural finish is scheduled.

3.5 APPLICATION

- A. General: Apply paints according to manufacturer's written instructions.
 1. Use applicators and techniques suited for paint and substrate indicated.
 - a. Except where specifically authorized by the Architect to do otherwise: Apply flat or eggshell wall paint by brush or roller; apply gloss or semi-gloss with brush only.
 2. Sanding: In addition to preparatory sanding, fine sand between succeeding coats of all varnish enamel or flat enamel, using sandpaper appropriate to the finish. Use fine production paper between coats.
 3. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 5. Doors: Finish all edges, including tops and bottoms, of wood and metal doors same as faces. Fill edges of exposed plywood doors, panels, similar materials.
 6. Finish interior of all closets and cabinets same as adjoining rooms, unless otherwise scheduled.
 7. Apply one coat of sanding sealer and one coat of semi-gloss varnish to insides of all drawers unless otherwise specified.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. The number of coats scheduled are minimums.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - 1. Holidays and restrikes in painted surfaces shall be considered sufficient cause to require recoating of entire surface.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.6 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of paint materials with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.7 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

****END OF SECTION****

OPERABLE PARTITIONS

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 work required under this Section consists of providing operable partitions, their accessories, and necessary mounting and installation hardware as indicated on the Drawings and as specified herein.
 - 1. Manually operated, paired panel partitions.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section "Alternates" for alternates that may affect the Work of this Section.
 - 2. Division 05 Section "Metal Fabrication" for structural steel support and miscellaneous steel framing.
 - 3. Division 06 Section "Rough Carpentry" for required blocking and framing for overhead support of track system.
 - 4. Division 09 Section "Gypsum Wallboard Assemblies" for wood or metal supports in metal stud wall system and plenum barriers.
 - 5. Division 26 sections for electrical power supply wiring and motor connections.

1.3 SUBMITTALS

- A. Product data on physical characteristics, durability, and surface-burning characteristics for each type of operable panel partitions and accessory specified.
- B. Submit shop drawings indicating model number, type of material, gauges or thickness of metal, finishes and details of construction, and attachment. Indicate unit conditions at openings, location and installation requirements for hardware and direction of travel.
 - 1. Include location and installation requirements for electrical operators.
- C. Wiring diagrams detailing power and control wiring. Differentiate between manufacturer-installed and field-installed wiring. Include motor size and voltage.
- D. Submit samples of complete finish color range to the Architect for selection. Submit test reports to the Architect on flame spread rating of covering fabric.
- E. Product certificates signed by manufacturers of operable panel partitions certifying that their products comply with specified requirements.
- F. Maintenance data for electric operation devices and panel finish face to include in the Operating and Maintenance Manual.

1. Precautions for cleaning materials and methods that could be detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

- A. Laboratory acoustical performance of the operable wall shall have been tested in an independent acoustical laboratory in accordance with ASTM E90 test procedure, and shall have attained an STC rating of no less than specified herein. A written test report by the test facility shall be available upon request.
- B. Surface-Burning Characteristics: Provide panel finish face with the following surface-burning characteristics as determined by testing identical products per ASTM E84 by UL or other testing and inspecting agencies acceptable to authorities having jurisdiction.
 1. Flame Spread: 25 or less.
 2. Smoke Developed: 450 or less.

1.5 WARRANTY

- A. Operable partitions shall be guaranteed against defects in materials and workmanship for a period of two (2) years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The approved model number and manufacturer is the product of Modernfold. New Castle, Indiana; specified as the type, size, function, and quality the operable partition requires.
- B. The following manufacturer's series will be considered, providing their operable partition equals or exceeds the quality specified, and they can provide a specific model of the type, size, function, and arrangement specified.
 1. Modernfold Corporation.
 2. Hufcor, Janesville, Wisconsin.

2.2 MANUALLY OPERATED, PAIRED PANELS

- A. Modernfold, Acousti-Seal 900 Series, paired panels, Model 932.
 1. Acceptable Products:
 - a. Hufcor, Series 600, Model 632.
- B. Sound Transmission Class: Partition shall meet the requirements of a minimum STC of 50 as determined in a full scale 14 feet by 9 feet opening in accordance with ASTM E90-70.
- C. Panel Construction: Shall be nominal 3.00 inches thick in standard widths not exceeding 48 inches.
 1. Panel frame shall be all steel, overlapped and welded at all corners to form a unitized frame.

2. Panel skins shall be:
 - a. 1/2 inch gypsum board.
 - b. Minimum 21gauge steel roll-formed and welded to the steel frame.
 3. Panels shall have a Class "A" flame spread rating when tested in accordance with ASTM E84 test procedure.
 4. Trim design shall provide a minimum "joint" appearance at vertical joints, with no exposed vertical trim.
- D. Panel Finish: Shall be factory applied.
1. Provide vinyl fabric with a total weight of not less than 16 oz. per lineal yard, 54 inches wide, conforming to Federal Specification CCC-W-408A, Type 2, and having a flame spread rating of 25 or less when tested in accordance with ASTM E84. Vinyl fabric shall be adhesively applied to panel skins not covered by chalkboards.
- E. Seals shall be provided at the perimeter of each panel as follows:
1. Vertical Seals: Shall consist of tongue and groove astragals interlocking a nominal .50 inch and providing stability and a light and sound seal.
 2. Bottom Seals: Shall consist of manually activated operable bottom seals providing nominal 2 inch operating clearance with an operating range of 1.5 inches.
 3. Top Seals: Shall be a continuous contact multi-finger vinyl sweep.
- F. Suspension Systems
1. Paired Panel, Modernfold Corp., Model 932
 - a. Track shall be dropped type as detailed on the Drawings. Supporting track shall be 2-1/2 inches by 2-1/8 inches by 11 gauge steel. Track layout shall be as indicated on Drawings.
 - b. Each panel shall be supported by a 4-wheel, steel tired ball bearing trolley. The steel trolley carriage shall be attached to the panel center with an adjustable 1/2-inch heat treated bolt.
 - c. No. 17 track system, racket mounted.
- G. Operation
1. Paired Panel, Modernfold Corp., Model 932
 - a. Unit shall consist of a system of top supported, manually operated panels hinged in pairs and center stacked.
 - b. Final closure shall be effected by a closure system as recommended by manufacturer, unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain and verify field dimensions, including finished ceiling height and finished flooring elevation. Verify also if finished flooring is carpet or vinyl tile. Field conditions shall be indicated on shop drawing submittal.

3.2 INSTALLATION

- A. Operable partitions shall be completely installed in accordance with manufacturer's directions, shop drawings, ASTM E 557, and as indicated.
- B. Take precautions necessary to properly protect the assemblies during and after installation.
- C. Train Owner's representative on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.

3.3 ADJUSTING

- A. Make necessary adjustments prior to final completion and acceptable of the building to achieve free and easy operation of the operable partitions.

****END OF SECTION****

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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 work of this Section.
- 1.2 SUMMARY
 - A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.
- 1.3 INDUSTRY STANDARDS
 - A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
 1. AABC – Associated Air Balance Council.
 2. ABMA - American Bearing Manufacturers Association.
 3. ABMA – American Boiler Manufacturers Association.

4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The).
5. AMCA - Air Movement and Control Association International, Inc.
6. ANSI – American National Standards Institute.
7. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers.
8. ASTM – American Society for Testing Materials.
9. CDA – Copper Development Association.
10. CGA – Compressed Gas Association.
11. CSA – CSA International.
12. HI – Hydraulic Institute.
13. Intertek – Intertek Group.
14. NAIMA – North American Insulation Manufacturers Association.
15. NEBB – National Environmental Balancing Bureau.
16. NEC – National Electrical Code.
17. NECA - National Electrical Contractors Association.
18. NEMA – National Electrical Manufacturer's Association.
19. NFPA – National Fire Protection Association.
20. SMACNA – Sheet Metal and Air Conditioning Contractors National Association.
21. UL – Underwriter's Laboratories, Inc.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 PERFORMANCE REQUIREMENTS

A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.5 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.
 - 1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.
 - 1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
 - 2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.
- C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.
- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.6 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

- D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.7 DRAWINGS

- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.8 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.
- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.
- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.9 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 SUBMITTALS

- A. Submit project specific submittals for review in compliance with Division 01.
- B. Prepare shop drawings to scale for the Architect/Engineer for review. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.
- C. All submittals shall be submitted in groupings of similar and/or related items. Plumbing fixture submittals shall be submitted as one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit shop drawing with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.

- D. All submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".
- E. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
- F. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
 - 1. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
 - 2. Contractor is responsible for:
 - a. Dimensions, which shall be confirmed and correlated at the job site.
 - b. Fabrication processes and techniques of construction.
 - c. Quantities.
 - d. Coordination of Contractor's work with all other trades.
 - e. Satisfactory performance of Contractor's work.
 - f. Temporary aspects of the construction process.
- G. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
- C. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- D. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:

1. Routine maintenance procedures.
2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
3. Trouble-shooting procedures.
4. Contractor's telephone numbers for warranty repair service.
5. Submittals.
6. Recommended spare parts lists.
7. Names and telephone numbers of major material suppliers and subcontractors.
8. System schematic drawings.

1.13 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 01.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warrant that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression;

Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION WORK

- A. All demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include all items such as, but not limited to, existing piping, draining of piping, pumps, ductwork, supports and equipment where such items are not required for the proper operation of the modified system.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner shall move and store these materials. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
- E. Clean and flush the interior and exterior of all existing relocated equipment and its related piping, valves, and accessories that are to be reused of all mud, debris, pipe dope, oils, welding slag, loose mill scale, rust and other extraneous material so that the existing equipment and all accessories can be repainted and repaired as required to place in first-class working condition.
- F. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling or at mains. Cap or plug piping with same or compatible piping material.
- G. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.
 - 1. Cap or plug piping with same or compatible piping material.
 - 2. Cap or plug ducts with same or compatible ductwork material.

3.2 REFRIGERANT HANDLING

- A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:

1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
 2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
 3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.
- B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.3 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.4 TEMPORARY SERVICES

- A. Provide temporary service as described in Division 01.
- B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional cost to the Owner.

3.5 WORK INVOLVING OTHER TRADES

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.6 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.

SECTION 200500
MECHANICAL
GENERAL
REQUIREMENTS

- B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.
- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:
 - 1. Air Handling Systems.
 - 2. Refrigeration Systems.
 - 3. Heating Systems.
 - 4. Steam Pressure Reducing Stations.
 - 5. Domestic Hot Water Heaters.
 - 6. Domestic Hot Water Mixing Stations.
 - 7. Energy Recovery Systems.
 - 8. Temperature Controls.
 - 9. Building Automation System.
 - 10. Exhaust Systems.
- F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

****END OF SECTION****

BASIC MECHANICAL MATERIALS AND METHODS

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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.

B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 22 Section "Domestic Water Piping" for flushing and cleaning of potable water piping.
3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for flushing and cleaning of HVAC piping.

1.2 SUMMARY

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheetmetal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.3 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:

1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. Welding certificates.
- C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- D. Comply with NSF 372, "Drinking Water System Components – Lead Content" for potable domestic water piping and components.
- E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- G. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- H. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."
- I. Installer Qualifications:
1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.

2. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
 1. Protect equipment and materials from theft, injury or damage.
 2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
 3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
 4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
 5. 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.
 6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
 1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.
- B. Unions: Pipe Size 2 Inches and Smaller:
 - 1. Ferrous pipe: Malleable iron ground joint type unions.
 - 2. Unions in galvanized piping system shall be galvanized.
 - 3. Copper tube and pipe: Bronze unions with soldered joints.
- C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
 - 1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
 - 2. Copper tube and pipe: Slip-on bronze flanges.
- D. 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 maximum thickness unless thickness or specific material is 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: Alloys meeting AWS A5.8.
 - 1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
 - 2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.
- I. 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.
- J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- K. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- L. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- M. Solvent Cements for Joining ABS Piping: ASTM D 2235.
- N. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.
- O. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 PIPE THREAD COMPOUNDS

- A. Pipe thread compounds for the fluid service compatible with piping materials provided.
- B. Compounds for potable water service and similar applications acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.
- C. Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds for galvanized carbon steel systems to coat raw carbon steel surfaces, in lieu of subsequent painting.
 - 1. Manufacturers:
 - a. Carboline "Carbo-Zinc 12."
 - b. Tnemec.
 - c. Koppers.
- D. Graphite and oil or proprietary corrosion inhibited compounds suitable for system temperatures for steam or condensate.
 - 1. Manufacturers:
 - a. WKM; Division of Cooper Industries, Inc., Key "Graphite Paste."
 - b. Other approved.

E. Use tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for natural gas system threaded joints.

1. Manufacturers:

- a. Cadillac Plastic.
- b. Permacel.
- c. Other approved.

2.5 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Dresser Industries, Inc.; DMD Div.
- c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
- d. JCM Industries.
- e. Smith-Blair, Inc.
- f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.

3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.

4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

- a. IPEX Inc. (formerly Eslon Thermoplastics).

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

- a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

- a. NIBCO INC.
- b. NIBCO, Inc.; Chemtrol Div.

- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Fernco, Inc.
- c. Mission Rubber Company.
- d. Plastic Oddities, Inc.
- e. Can-Tex Industries Division of Harsco Corp. "CT-Adaptors".
- f. Joint Inc., "Caulder".

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.
- D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Capitol Manufacturing Co.
- d. Central Plastics Company.
- e. Epco Sales, Inc.
- f. Pipeline Seal and Insulator, Inc.
- g. Watts Water Technologies, Inc.; Watts Regulator Co.
- h. Zurn Industries, Inc.; Wilkins Div.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; female NPT threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

- a. Lochinvar Corp.; V-Line Insulating Couplings.

- F. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.

1. Manufacturers:

- a. Anvil International, Inc.; Gruvlok Manufacturing; DI-LOK Nipples.
- b. Elster Group; Perfection Corp.; ClearFlow.

- c. Precision Plumbing Products, Inc.; ClearFlow.
- d. Sioux Chief Manufacturing Co., Inc.
- e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
- f. Victaulic Co. of America; Style 47 ClearFlow.

2.7 MODULAR MECHANICAL SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Innerlynx.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.
 - 2. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 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.

2.8 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.9 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.11 EPOXY BONDING COMPOUND

- A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.
- B. Manufacturers:
 1. Euco 452 #450; Euclid Chemical Co.
 2. Epobond; L & M Construction Chemicals.
 3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

- A. Commercial leak detector solution for pipe system testing.
- B. Manufacturers:
 1. American Gas and Chemicals Inc.; Leak Tec.
 2. Cole-Parmer Inst. Co.; Leak Detector.
 3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.13 PIPE ROOF PENETRATION ENCLOSURES

- A. Manufacturers:
 1. Pate Company (The).
 2. Portals Plus, Inc.
 3. Thybar Corporation; Thycurb.

- B. Minimum 18 gage welded galvanized steel construction.
- C. Integral base plate.
- D. Built-in fully mitered cant.
- E. Factory installed insect and decay resistant wood nailer.
- F. Factory installed 1-1/2 inch thick, 3 pounds per cubic foot density rigid insulation.
- G. EPDM compression molded rubber cap for single or multiple pipes as required.
- H. Stainless steel draw-band clamps.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Refer to piping application schedules on the Drawings.
- B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- C. 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. The Drawings shall be followed as closely as elements of construction will permit.
- D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.
- F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- G. Brazoletts can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- H. Clean and lubricate elastomer joints prior to assembly.
- I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- J. Install piping to conserve building space and not interfere with use of space.
- K. Group piping whenever practical at common elevations.
- L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- M. Slope piping and arrange systems to drain at low points.

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- N. Slope horizontal piping containing noncondensable gases 1 inch per 100 feet, upward in the direction of the flow.
- O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- P. 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.
- Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- R. Do not penetrate building structural members unless specifically indicated on drawings.
- S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- T. Install valves with stems upright or horizontal, not inverted.
- U. Provide clearance for installation of insulation and access to valves and fittings.
- V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.
- X. Install piping free of sags and bends.
- Y. Install fittings for changes in direction and branch connections.
- Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
 - 1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
 - 2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.
- AA. Install piping to allow application of insulation.
- BB. Select system components with pressure rating equal to or greater than system operating pressure.
- CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections "Hydronic Piping," "Piping Systems Flushing and Chemical Cleaning," and "HVAC Water Treatment."
- DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.

- EE. Sleeves are not required for core-drilled holes in poured concrete walls.
- FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.
- GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
 - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
 - d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
 - e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
 4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 5. Seal sleeves in plaster/gypsumboard partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
 6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
 2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
 3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
 - 1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - JJ. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.
 - 1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - KK. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Specification Sections for materials.
 - LL. Seal openings around pipes in sleeves and around duct openings through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Fire and/or smoke barriers shall be UL listed firestopping and shall have a fire rating equal to or greater than the penetrated barrier. Refer to Division 07 Specification Sections for materials.
 - MM. Pipe Roof Penetration Enclosures:
 - 1. Coordinate delivery of roof penetration enclosures to jobsite.
 - 2. Locate and set curbs on roof.
 - 3. Framing, flashing, and attachment to roof structure are specified under Division 07.
 - 4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.
 - NN. Verify final equipment locations for roughing-in.
 - OO. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.
 - B. Cut piping square.
 - C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

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- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.
- E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.
- H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.
- I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- J. Provide temperature sensing device thermal wells and similar piping specialty connections.
- K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.
- L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.
- M. 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."
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- O. 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.
- P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
 - 1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

- Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
 2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
- R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- S. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- T. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- U. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.
- V. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

- W. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- X. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- Y. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.3 ACCESS DOORS

- A. Provide access doors for installation by architectural trades unless noted otherwise. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.
- B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.4 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
 - 1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.
- B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
- F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
- G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.7 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

- A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.
- B. 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 as shown on Drawings or specified, but not less than 4 inches 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 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, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.9 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 mechanical materials and equipment.
- C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.
- D. Field Welding: Comply with AWS D1.1.

3.10 EPOXY BONDING TO EXISTING MATERIALS

- A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.
- B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.11 JACKING OF PIPE

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.12 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical 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.

3.13 GROUTING

- A. Mix and install grout for mechanical 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.

3.14 CUTTING, CORING AND PATCHING

- A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.
- B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.15 EXCAVATION AND BACKFILLING

- A. Refer to Division 31 Specification Sections.
- B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.
- C. Provide all pumping and/or well pointing required for the mechanical work.
- D. Provide foundations if required to support underground piping.
- E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.16 FLASHING

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.17 LUBRICATION

- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.18 FILTERS

- A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.
- B. Immediately prior to final building acceptance by the Owner, Contractor shall:
 - 1. Replace all disposable type air filters with new units.

3.19 CLEANING

- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.
- B. After equipment and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems

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Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

- C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."
- E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
- F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

****END OF SECTION****

PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Refrigerant Piping."

1.2 DEFINITIONS

- A. BR: Butyl rubber.
- B. CR: Chlorosulfonated polyethylene synthetic rubber (Neoprene).
- C. CSM: Chlorosulfonyl-polyethylene rubber (Hypalon).
- D. EPDM: Ethylene-propylene-diene terpolymer rubber.
- E. NBR: Buna-N/Nitrile rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of pipe flexible connector, expansion joint and alignment guide indicated.
- B. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
- C. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- D. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.
- E. Welding certificates.
- F. Operation and Maintenance Data: For pipe expansion joints to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

PART 3 - EXECUTION

3.1 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

****END OF SECTION****

HANGERS AND SUPPORTS

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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.
- B. Related Sections include the following:
 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 2. Division 21 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
 3. Division 20 Section "Mechanical General Requirements."
 4. Division 20 Section "Basic Mechanical Materials and Methods."
 5. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
 6. Division 20 Section "Pipe Expansion Fittings and Loops" for pipe guides and anchors.

7. Division 23 Section(s) "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
B. MFMA: Metal Framing Manufacturers Association.

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture.
 2. MSS SP-69, Pipe Hangers and Supports – Selection and Application.
 3. MSS SP-89, Pipe Hangers and Supports – Fabrication and Installation Practices.
- B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.2, "Structural Welding Code--Aluminum."
 3. AWS D1.3, "Structural Welding Code--Sheet Steel."

4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HANGER ROD MATERIAL

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
 1. Rod continuously threaded.
 2. Use of rod couplings is prohibited.

2.3 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-69, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
 1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.
- B. Manufacturers:
 1. Anvil International, Inc.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. Hilti USA.
 5. ERICO International Corp.
 6. PHD Manufacturing, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.4 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. Anvil International, Inc.; Anvil-Strut.
 - 2. B-Line by Eaton.
 - 3. Power-Strut Div.; Tyco International, Ltd.
 - 4. Unistrut Corp.; Tyco International, Ltd.
 - 5. Hilti USA.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 METAL INSULATION SHIELDS

- A. Manufacturers:
 - 1. Anvil International, Inc.
 - 2. B-Line by Eaton.
 - 3. Carpenter & Paterson, Inc.
 - 4. ERICO International Corp.
 - 5. PHD Manufacturing, Inc.
- B. Description: MSS SP-69, Type 40, protective shields. Shields shall span an arc of 180 degrees.
- C. Shield Dimensions for Pipe: Not less than the following:
 - 1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.7 PIPE COVERING PROTECTION SADDLES

- A. Manufacturers:
 - 1. Anvil International, Inc.
 - 2. B-Line by Eaton.
 - 3. Carpenter & Paterson, Inc.
 - 4. ERICO International Corp.

5. PHD Manufacturing, Inc.

B. Description: MSS SP-69, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.

1. Saddles shall match insulation thickness.
2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.8 PLASTIC INSULATION SHIELDS

A. Manufacturers:

1. B-Line by Eaton; Snap'N Shield.

B. Description: Polypropylene copolymer protective shields designed to snap directly onto strut channel. Shields shall span an arc of 180 degrees.

1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F.

C. Certifications:

1. UL Classified for USA: UL-723 (ASTM E 84).
2. UL listed for Canada: ULC-S102.2.
3. Meets UL94 HB flammability standards.

D. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 2: 12 inches long.

2.9 THERMAL-HANGER SHIELDS

A. Manufacturers:

1. B-Line by Eaton.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
3. Rilco Manufacturing Company, Inc.
4. American Mechanical Insulation Sales Inc. (AMIS).
5. ERICO International Corp.
6. Value Engineered Products, Inc.

B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.

1. Minimum Compressive Strength of Insert Material:

- a. 100-psig- for sizes smaller than NPS 6.
 - b. 600-psig- for sizes NPS 6 and larger.
- C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
- F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.
- G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:
 - 1. Manufacturer:
 - a. B-Line by Eaton/Armacell; Armafix IPH.
 - 2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:
 - a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.
- H. Thermal-Hanger Shields for Small Diameter Piping:
 - 1. Manufacturer:
 - a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
 - 2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
 - a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 1-1/2 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.10 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line by Eaton.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

- B. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.

1. Manufacturers:

- a. Hilti, Inc.
- b. ITW Ramset/Red Head.
- c. MKT Fastening, LLC.
- d. Powers Fasteners.

2. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

3. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.

4. Washer and Nut: Zinc-coated steel.

- C. Threaded Inserts: Galvanized malleable iron or galvanized steel for 3/4 inch bolts.

1. Manufacturers:

- a. Superior Concrete Accessories; Threaded Insert.
- b. Dayton Sure-Grip and Shore Co.
- c. Richmond Screw Anchor Co.

- D. Slotted Inserts: Continuous galvanized steel with temporary slot fillers and complete with nuts, studs, washers and the like, for 3/4 inch bolts.

1. Manufacturers:

- a. B-Line by Eaton; B22-I Continuous Concrete Insert.
- b. Unistrut Corp.; P-3200 Continuous Insert.
- c. Hohman and Barnard, Inc.
- d. Richmond Screw Anchor Co.
- e. Hilti, Inc.; CIS13812/PG.

2.11 ROOF AND GRADE MOUNTED PIPING SUPPORTS

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

- B. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

- a. B-Line by Eaton; Dura-Blok.
- b. Eco Support Products.
- c. ERICO International Corp.
- d. MIRO Industries; Conduit and Condensate Supports.
- e. Portable Pipe Hangers.

2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
- C. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. ERICO International Corp.
 - d. MIRO Industries; Conduit and Condensate Supports.
 - e. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- D. High, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and clevis type pipe support, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. ERICO International Corp.
 - d. MIRO Industries; Water and Steam Supports.
 - e. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- E. Low, Fixed-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. ERICO International Corp.
 - d. MIRO Industries; Gas and Mechanical Supports.

- e. Portable Pipe Hangers.
 - 2. Base: Plastic, stainless steel, or recycled rubber.
 - 3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
- F. Low, Adjustable-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
- 1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. ERICO International Corp.
 - d. MIRO Industries; Gas and Mechanical Supports.
 - e. Portable Pipe Hangers.
 - 2. Base: Plastic, stainless steel, or recycled rubber.
 - 3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
 - 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- G. High, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
- 1. Manufacturer:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. ERICO International Corp.
 - d. MIRO Industries; Water and Steam Supports.
 - e. Portable Pipe Hangers.
 - 2. Bases: Two or more plastic, steel, or recycled rubber.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- H. Custom, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports or rollers, for roof installation without membrane penetration.
- 1. Manufacturer:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. ERICO International Corp.
 - d. MIRO Industries; Custom Design Products.

- e. Portable Pipe Hangers.
- 2. Bases: Four or more plastic, steel, or recycled rubber.
- 3. Vertical Members: Two or more protective-coated-steel channels.
- 4. Horizontal Member: Protective-coated-steel channel.
- 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- 6. Pipe Rollers: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
- I. Curb-Mounting Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.
 - 1. Roof Curb Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
 - a. Manufacturers:
 - 1) Pate.
 - 2) Thybar; Thycurb.
 - 3) Roof Products and Systems.
 - 4) Greenheck.
 - 5) Creative Metals.

2.12 ROOF MOUNTED EQUIPMENT SUPPORTS

- A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.
- B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. ERICO International Corp.
 - c. MIRO Industries; HD and LD Mechanical Unit Supports.
 - d. Portable Pipe Hangers.
 - 2. Base: Plastic, stainless steel, or recycled rubber.
 - 3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rod, and accessories.
- C. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.
 - 1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.

a. Manufacturers:

- 1) Pate.
- 2) Thybar; TEMS Series.
- 3) Roof Products and Systems.
- 4) Greenheck.
- 5) Creative Metals.

2.13 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.14 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, 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, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Refer to application schedules on the Drawings.
- B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.
- C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- D. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.
- F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
- G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.
- H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- I. Use padded hangers for piping that is subject to scratching.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. MSS Type 8 or spring type to meet system requirements.

- 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 up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F 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 piping installations.
- L. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
 2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch NPS 4 reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
 3. Use mechanical-expansion anchors where required in concrete construction.
 4. Use chemical fasteners where required in concrete construction.
- M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Beam Clamps:
 - a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
 - b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:
 - a. Provide spring supports at point of support where vertical movement will occur.
 - b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.

- c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
 - d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
 - e. Sway braces; TYPE 50.
 - f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.
- O. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel 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 building structural frame.
- B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.
- C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
- E. File and paint cut ends and shop or field prime paint supporting element components.
- F. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
- G. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
- H. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.
- I. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.

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- J. Where necessary, brace piping and supports against reaction, sway and vibration.
- K. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.
- L. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- M. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- N. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.
- O. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.
- P. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.
- Q. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
- R. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
- S. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.
- T. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
- U. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
- V. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
- W. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- X. Building structure shall not be reinforced except as approved by the Architect in writing.
- Y. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with

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applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.

- Z. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
- AA. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.
- BB. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.
- CC. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.
- DD. 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 above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- EE. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- FF. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- GG. Roof-Mounting Pipe and Equipment Stand Installation:
 - 1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.
 - 3. Maintain support manufacturer's recommended spacing.
- HH. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- II. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- JJ. 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.
- KK. Install lateral bracing with pipe hangers and supports to prevent swaying.
- LL. 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 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.
- MM. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- NN. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- OO. Refer to individual piping sections for hanger spacing and hanger rod sizes.

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 smooth bearing surface.
- 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 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 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.

3.6 PAINTING

- A. Touch Up: 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.
- B. Equipment Supports: Painting is specified in Division 09 painting Sections.
- C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

****END OF SECTION****

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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.
 - B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
- 1.2 SUBMITTALS
 - A. Product Data: For each type of product indicated.
 - B. Samples: For color, letter style, and graphic representation required for each identification material and device.
 - C. Valve numbering scheme.
 - D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.
- 1.3 QUALITY ASSURANCE
 - A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.4 COORDINATION

- 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Seton.
 - 2. Brady.
 - 3. EMED.
 - 4. Craftmark.
 - 5. Brimar Industries, Inc.
 - 6. Marking Services Inc. (MSI).
 - 7. Kolbi Pipe Marker Co.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.

- d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
- 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Data: Instructions for operation of equipment and for safety procedures.
 - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 - 3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
 - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
 - 2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
 - 3. Legends: Spelled out in full or commonly used and accepted abbreviations.
 - 4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 - 5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 - 6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.
- F. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.
- G. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.
- B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect/Engineer. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Finished hardwood or extruded aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 WARNING TAGS

- A. Warning Tags: 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 minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 2. Fans, blowers, primary balancing dampers, and mixing boxes.
 3. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.

- f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.
 - j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 - 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 - 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.
- E. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.

2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 through walls, floors, ceilings, and nonaccessible 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.
- C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.4 DUCT IDENTIFICATION

- A. Install engraved duct markers with permanent adhesive on air ducts in the following color codes:
1. Refer to Schedule.
 2. ASME (ANSI) A13.1 Colors and Designs: For hazardous material exhaust.
 3. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Identify ductwork with vinyl markers and flow direction arrows.
- C. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; 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. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

- a. Cold Water: Minimum 1-1/2 inches, round or square.
- b. Hot Water: Minimum 1-1/2 inches, round or square.
- c. Fire Protection: Minimum 1-1/2 inches, round or square.

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.10 SCHEDULES

- A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>	<u>Piping</u>
Sanitary Sewer	SAN	White on Green	Dark Brown
Sanitary Vent	V	White on Green	Dark Brown
Rain Conductor	RC	White on Green	Dark Brown
Domestic Cold Water	CW	White on Green	Light Green
Domestic Hot Water	HW	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Hot Water Htg. Supply	HWHS	Black on Yellow	Dark Blue
Hot Water Htg. Return	HWHR	Black on Yellow	Dark Blue
Chilled Water Supply	CHWS	White on Green	Light Blue
Chilled Water Return	CHWR	White on Green	Light Blue
Refrigerant Liquid	RL	Black on Yellow	
Refrigerant Suction	RS	Black on Yellow	
Fire Protection	FP	White on Red	Bright Red

SECTION 200553
MECHANICAL
IDENTIFICATION

<u>Service</u>	<u>SHEET METAL WORK</u> <u>Abbrev.</u>	<u>Labels</u>	<u>Ductwork</u>
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White
Mixed Air	Mixed Air	White on Green	White

END OF SECTION

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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.
- B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 20 Section "Basic Materials and Methods."
3. Division 20 Section "Hanger and Supports" for thermal hanger shield inserts.
4. Division 22 Section "Plumbing Fixtures: for protective shielding guards.
5. Division 23 Section "Metal Ducts" for duct liners.

1.2 SUMMARY

- A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVC: Polyvinyl Chloride.
- E. PVDC: Polyvinylidene chloride.
- F. SSL: Self-sealing lap.

1.4 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

1.5 OUTDOOR, ABOVEGROUND PIPING INSULATION SYSTEMS DESCRIPTION

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

1.6 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

- A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.7 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

- A. Acceptable outdoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.8 EXTERNAL DUCT LAGGING SYSTEM

- A. System for controlling low frequency sound transmission in metal ducts consisting of:
 1. One layer of 1-inch thick rigid fiberglass duct board.
 2. Two layers of 5/8-inch thick gypsum board.

1.9 EQUIPMENT INSULATION SYSTEMS DESCRIPTION

- A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.10 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1. ESR Report: For fire-rated grease duct insulation.

- B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Insulation application at pipe expansion joints for each type of insulation.
3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Removable insulation at piping specialties, equipment connections, and access panels.
5. Application of field-applied jackets.
6. Application at linkages of control devices.
7. Field application for each equipment type
8. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

- C. Field quality-control inspection reports.

1.11 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, and cement material containers, with appropriate markings of applicable testing and inspecting 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.

- C. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.

1.13 COORDINATION

- A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 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.

1.14 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, GENERAL REQUIREMENTS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.2 PIPE INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Armacell LLC; AP Armaflex.
 - b. Nomaco K-Flex; Insul-Tube and Insul-Sheet.
- B. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

C. Mineral-Wool, Preformed Pipe Insulation, Type II:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Rock Wool Manufacturing Company; Delta PC and PF.
 - c. Roxul Inc.; 1200 Pipe Insulation.
2. Type II, 1200 deg F Materials: Mineral wool fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 DUCTWORK INSULATION MATERIALS

- A. Blanket Insulation: 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 Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap FSK.
 - e. Owens Corning; All-Service Duct Wrap.
- B. Board Insulation: 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 ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 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.

2.4 DUCTWORK LAGGING MATERIALS

- A. Board Insulation: Minimum 3 pounds per cubic foot density, glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Johns Manville; 800 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Manson Insulation Inc.; AK Board.
 - e. Owens Corning; Fiberglas 700 Series.
- B. Gypsum Board: Gypsum core wall panel surfaced with paper on front, back, and long edges.
 - 1. Comply with ASTM C 1396.
 - 2. Edges: Square.
- C. Acoustical Sealant:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Acoustical Surfaces, Inc.; Noise S.T.O.P. Sealant.
 - b. Johns Manville; Dux Seal.

2.5 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 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, provide one of the products specified.
 - 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, provide one of the products specified.
 - 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.

2.6 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Armacell LCC; 520 Adhesive.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - c. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; 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.
 - f. Vimasco Corporation.
- D. 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, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; 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. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.7 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, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; 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 at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 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, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; 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 at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.8 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, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; 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.
4. Color: White.

2.9 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; 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.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, 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.
5. Color: White.

C. Joint Sealants for Cellular-Glass, Phenolic-Foam, and Polyisocyanurate:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; 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.
5. Color: White or gray.

2.10 FACTORY-APPLIED JACKETS

- A. Insulation systems 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.

2.11 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Zeston and Ceel-Co.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated tank heads and tank side panels.
- D. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Zeston and Ceel-Co.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by manufacturer.
 3. Color: White.

4. Factory-fabricated fitting covers:

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

E. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. PABCO-Childers Metals; ITW Insulation Systems; Metal Jacketing Systems.
- b. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

- a. Sheet and roll stock ready for shop or field sizing or 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- thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
- e. Factory-Fabricated Fitting Covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
 - 3) 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. Sheet and roll stock ready for shop or field sizing factory cut and rolled to size.
- b. Material, finish, and thickness are indicated in field-applied jacket systems.
- c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
- e. Factory-Fabricated Fitting Covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
 - 3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

F. Self-Adhesive Outdoor Jacket: Laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. MFM Building Products Corp.; FlexClad-400
 - b. Polyguard; Alumaguard.
 - c. Venture Tape Corp.; VentureClad.
- G. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.
- H. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The), Saran 560 Vapor Retarder Film.
- I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
- J. Sound Barrier Jacket: Uni-composite film laminated to 0.020 inch thick stucco embossed aluminum using viscoelastic film adhesive.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; ITW Insulation Systems; 1 pound Muffl-Jac.
 - 2. Properties:
 - a. Sound Transmission Class (STC): 29.
 - b. Thickness (film): 0.080 to 0.110 inch.
 - c. Weight (film): 1 pound per square foot.
 - d. Service Temperature Range: Minus 40 deg F to 180 deg F.
 - 3. Proprietary sound jacketing by steam pressure reducing valve manufacturer is also acceptable.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch 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 and UL listed.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 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.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; ITW Insulation Systems; Pab-Bands and Fabstraps.
 - b. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

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- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 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.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 1. Manufacturers:
 - a. ACS Industries, Inc.
 - b. C & F Wire.
 - c. PABCO-Childers Metals; ITW Insulation Systems.
 - d. RPR Products, Inc.

2.14 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, 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 thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. 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 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 COMMON 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 the 4 o'clock or 8 o'clock position on 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 as recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 thermal hanger 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 thermal hanger 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches 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. For below ambient services, 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. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- 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 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 below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade 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.
 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:
 1. Terminate ductwork insulation at angle closure of fire damper sleeves.
 2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."

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 angle closure of fire damper sleeves.
2. Pipe: Install insulation continuously through floor penetrations.
 - a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

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, 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, 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 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 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.
- E. Install removable and reusable insulation covers in accordance with fabricator's instructions, and at the following locations:

3.6 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

- 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.

3.7 GLASS-FIBER AND MINERAL WOOL PIPE 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. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
3. For piping systems with surface temperatures below ambient, install a continuous unbroken vapor barrier. Seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - a. 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. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

B. Insulation Installation on Pipe Flanges:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
 - a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install PVC fitting covers when available.
2. When PVC fitting covers 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 PVC fitting covers when available.
2. When PVC fitting covers 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.

3.8 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with 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. Adhesive may be omitted from top surface of horizontal rectangular ducts.
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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches 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 over compress 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 from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches 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 over compress 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 from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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 2 times the insulation thickness but not less than 3 inches.
- 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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.
 - 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.
 - 3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer's installation instructions.

3.9 DUCT LAGGING INSTALLATION

- A. Install between silencers and shaft or Mechanical Equipment Room walls, and where indicated on Drawings.
- B. Ensure sufficient clearance between ductwork to be lagged and adjacent items.
- C. Install lagging as detailed on Drawings.
- D. Adhere board insulation with adhesive. Do not use pins.
- E. Install gypsum board layers. Stagger joints between layers. Seal joints with acoustical sealant.

3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.
 - 2. For services with surface temperatures below ambient, maintain continuous unbroken vapor barrier.
- C. Where metal jackets are indicated, install with 2-inch 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 o.c. and at end joints.
- D. Where sound barrier jackets are indicated, install in accordance with manufacturer's instructions.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - 2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 - 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 - 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish mouthing," and use PVDC tape along lap seal to secure joint.
 - 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

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- 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.

****END OF SECTION****

HVAC AIR-DISTRIBUTION SYSTEM CLEANING

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Metal Ducts."
 - 3. Division 23 Section "Nonmetal Ducts."
 - 4. Division 23 Section "Duct Accessories."

1.2 SUMMARY

- A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.
- C. VSMR: Ventilation system mold remediator.

1.4 SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Qualification Data: For an VSMR.

- C. Strategies and procedures plan.
- D. Cleanliness verification report.

1.5 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. VSMR Qualifications: A certified member of NADCA.
 - 1. Certification: Employ a VSMR certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as a VSMR by NADCA.
- C. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE AGENCIES

- A. Engage a NADCA member company with qualified ASCS and VSMR to clean HVAC air distribution systems.
 - 1. Acceptable HVAC air distribution system cleaning companies:
 - a. ACCU-Clean Services, LLC.; Hazel Park, MI.
 - b. Dalton Environmental Cleaning Corp.; Whitmore Lake, MI.
 - c. DUCTZ; Ann Arbor, MI.
 - d. Dusty Ducts, Inc.; Melvindale, MI.
 - e. Fresh Air Solutions, Inc.; Carleton, MI.
 - f. Safety King, Inc.; Utica, MI.
 - g. Sani-Vac Service, Inc.; Warren MI.

3.2 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:

1. Supervisor contact information.
 2. Work schedule including location, times, and impact on occupied areas.
 3. Methods and materials planned for each HVAC component type.
 4. Required support from other trades.
 5. Equipment and material storage requirements.
 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.4 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
1. Air devices for supply and return air.
 2. Air-terminal units.
 3. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air ducts.
 4. Air-Handling Units:
 - a. Interior surfaces of the unit casing.
 - b. Coil surfaces compartment.
 - c. Condensate drain pans.
 - d. Fans, fan blades, and fan housings.
 5. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.

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2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
 2. Cleaning Mineral-Fiber Insulation Components:

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- a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
- b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
6. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.5 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.

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- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Additional Verification:
 - 1. Perform surface comparison testing or NADCA vacuum test.
 - 2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
- E. Verification of Coil Cleaning:
 - 1. Measure static-pressure differential across each coil.
 - 2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of, the differential measured when the coil was first installed.
 - 3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- F. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.
- G. Photographic Documentation: Comply with requirements in Division 01 Section "Photographic Documentation."

3.6 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Division 23 Section "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Division 23 Sections "Metal Ducts" and "Nonmetal Ducts."
- D. Replace damaged insulation according to "Division 23 Section "HVAC Insulation."
- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

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G. Reseal fibrous-glass ducts. Comply with requirements in Division 23 Section "Nonmetal Ducts."

****END OF SECTION****

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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.
 - B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 20 Section "Basic Mechanical Materials and Methods."
 3. Division 23 Section "Testing, Adjusting, and Balancing."
- 1.2 SUMMARY
 - A. This Section includes common requirements for fans and air moving equipment.
- 1.3 SUBMITTALS
 - A. Product Data: For the following:
 1. Fan bearings.
 2. V-belt fan drives.

3. Direct drive couplings.

1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. Fan Performance Data: AMCA Standard 210.
- C. Sound Power Level Ratings:
 1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
 2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 FAN SHAFTS

- A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.3 FAN POWER TRANSMISSION

- A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.
- B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.
- C. Base horsepower rating of drive on minimum pitch diameter of small sheave.
- D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.
- E. Adjust belt tension in accordance with the manufacturer's recommendations.
- F. Perform alignment and final belt tensioning in the presence of the Architect.

2.4 SHEAVES

- A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.
- B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.
- C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.
- D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.
- E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.
- F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.5 V-BELT FAN DRIVES

- A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.
- B. Manufacturers:
 - 1. Emerson Power Transmission; Browning.
 - 2. Rockwell Automation; Dodge.
 - 3. T.B. Wood's Incorporated.

2.6 FAN DRIVE, SHAFT, AND COUPLING GUARDS

- A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.
- B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.
- C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.
- D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings

for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

- E. Centrifugal exhaust fans shall be provided with shaft seals.

2.7 BELT DRIVE GUARDS

- A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.
- B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.8 V-BELTS

- A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.
- B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.
- C. Manufacturers:
 - 1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
 - 2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
 - 3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.9 V-BELT DRIVE MOTOR BASES

- A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.
- B. Provide for adjustment of both belt tension and alignment.

2.10 AIR HANDLING SYSTEM BALANCING PROVISIONS

- A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.
- B. Provide sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each existing air handling system requiring rebalancing during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 FLEXIBLE COUPLINGS (DIRECT DRIVE)

- A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.
- B. Manufacturer:
 - 1. Falk Corporation (The).

2.12 MOTOR REQUIREMENTS

- A. Furnish motors in accordance with Division 20 Section "Motors."

2.13 FAN BEARINGS

- A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.
 - 1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
 - 2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.

2.14 IDENTIFICATION

- A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.15 ACCESSORIES

- A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
- B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
- C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

****END OF SECTION****

GENERAL-DUTY VALVES FOR HVAC

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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.
- B. Related Sections include the following:
 - 1. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
 - 2. Division 20 Section "Mechanical Identification" for valve tags and charts.
 - 3. Division 22 Section "General-Duty Valves for Plumbing" for plumbing valves.
 - 4. Division 23 Section "Temperature Controls" for control valves and actuators.

1.2 SUMMARY

- A. This Section includes valves for general HVAC applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.6 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, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.

6. 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 VALVES, GENERAL

- A. Isolation valves are scheduled on the Drawings. For other general HVAC valve applications, use the following:
1. Throttling Service: Angle, ball, butterfly, or globe valves.
 2. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- D. For valves not indicated in the Application Schedules, select valves with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 7. For Grooved-End Systems: Valve ends may be grooved. Do not use for steam or steam condensate piping.
- 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 Sizes: Same as upstream pipe, unless otherwise indicated.

G. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

H. Extended Valve Stems: On insulated valves.

I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

J. Valve Grooved Ends: AWWA C606.

K. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

L. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 70-140.
 - b. Crane Co.; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company; Model BA100S.
 - e. NIBCO INC.; Models S-580-70-66 or T-580-70-66.
 - f. Watts Water Technologies, Inc.

C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; by Conbraco Industries, Inc.; Series 77C-140.
- b. Crane Co.; Crane Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.; Models S-585-70-66 or T-585-70-66.
- f. Watts Water Technologies, Inc.

2.3 GENERAL SERVICE BUTTERFLY VALVES

- A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
 1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
 2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.
- B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.
 - b. Bray International, Inc.
 - c. DeZurik.
 - d. Forum Energy Technologies; ABZ Valve.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.; LD-2000-3/5.
 - h. Pentair Valves & Controls; Keystone.
 - i. Tyco Flow Control; Grinnell Flow Control.
 - j. Watts Water Technologies.
- C. Lug-Style (Single-Flange) Size NPS 14 and Larger, 150-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, and phenolic-backed EPDM seat (liner) attached to the body.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.
 - b. Bray International, Inc.
 - c. DeZurik.
 - d. Forum Energy Technologies; ABZ Valve.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.; LD-1000-5.
 - h. Pentair Valves & Controls; Keystone.

- i. Tyco Flow Control; Grinnell Flow Control.
 - j. Watts Water Technologies.
- D. Grooved-End Butterfly Valves with EPDM-Encapsulated Ductile-Iron Disc: Ductile-iron body with grooved or shouldered ends and polyamide coating inside and outside; Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. NIBCO INC.; Model GD-4765-3/5.
 - c. Tyco Fire & Building Products; Grinnell Mechanical Products.
 - d. Victaulic Co. of America.

2.4 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Class 150, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 300 psig CWP rating.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valves.
 - c. Crane Co.; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company; Model 515.
 - f. NIBCO INC.; Models S-433-B or T-433-B.
 - g. Watts Water Technologies.

2.5 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves, General: MSS SP-71.
- B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valves.
 - c. Crane Co.; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company; Model F-2974.
 - f. NIBCO INC.; Model F-918-B.
 - g. Watts Water Technologies.

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- C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valves.
 - c. Crane Co.; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company; Model F-2970.
 - f. NIBCO INC.; Model F-968-B.
 - g. Watts Water Technologies.
- D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mueller Co.
 - b. NIBCO, INC.; Model G-917-W.
 - c. Tyco Fire & Building Products; Grinnell Mechanical Products.
 - d. Victaulic Co. of America.

2.6 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.; Model S-480-Y or T-480-Y.
 - d. The Wm. Powell Company.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 250 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 584 Alloy C844, bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: PTFE, or TFE.

2.7 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

- A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

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- B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model W-910-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.
- C. Class 250, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 400 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model W-960-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.
- D. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model F-910-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.
- E. Class 250, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 400 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model F-960-B.
 - b. Mueller Steam Specialty.
 - c. Milwaukee Valve Company.
 - d. Hammond Valve.

2.8 BRONZE GLOBE VALVES

- A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.
- B. Class 150, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 300 psig CWP rating.

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1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company; Model 590.
 - e. NIBCO INC.; Models S-235-Y or T-235-Y.
 - f. Watts Water Technologies, Inc.

2.9 CAST-IRON GLOBE VALVES

- A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.
- B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.
 1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valves.
 - c. Crane Co.; Stockham Valves.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company; Model F-2981.
 - f. NIBCO INC.; Model F-718-B.
 - g. Watts Water Technologies, Inc.

2.10 BRONZE ANGLE VALVES

- A. Bronze Angle Valves, General: MSS SP-80, with silicon bronze stem, non-asbestos packing and malleable-iron handwheel.
- B. Class 150, Bronze Angle Valves: ASTM B 62 bronze body with TFE disc, union-ring bonnet, threaded ends, and having 300-psig CWP rating.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valves.
 - b. Crane Co.; Stockham Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company; Model 595T.
 - e. NIBCO INC.; Model T-335-Y.
 - f. The Wm. Powell Company.

2.11 CAST-IRON ANGLE VALVES

- A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.
- B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.; Model F-818-B.
 - b. Crane Co.; Stockham Valves.
 - c. Crane Co.; Crane Valves.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Bronze ball valve as specified in this Section.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.

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- F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.
- G. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 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.

****END OF SECTION****

TESTING, ADJUSTING, AND BALANCING

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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. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 20 Section "Basic Mechanical Materials and Methods."
 3. Division 23 Section "Common Work Results for HVAC."

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:

1. Air Systems:
 - a. Constant-volume air systems.
 - b. Dual-duct systems.
 - c. Variable-air-volume systems.
 - d. Multizone systems.
 - e. Induction-unit systems.
 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 - c. Primary-secondary systems.
 3. HVAC equipment quantitative-performance settings.
 4. Laboratory fume hood airflow balancing.
 5. Exhaust hood airflow balancing.
 6. Existing systems TAB.
 7. Verifying that automatic control devices are functioning properly.
 8. Reporting results of activities and procedures specified in this Section.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. NC: Noise criteria.
- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. RC: Room criteria.
- I. Report Forms: Test data sheets for recording test data in logical order.

- J. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- K. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- L. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- M. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- N. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- O. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- P. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- Q. TAB: Testing, adjusting, and balancing.
- R. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- S. Test: A procedure to determine quantitative performance of systems or equipment.
- T. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

- B. Smoke Control System Testing: Additional Qualifications: The TAB firm shall be a qualified special inspector for the smoke control systems. The TAB firm for the smoke control system shall have expertise in fire protection engineering, mechanical engineering, and certification as air balancers.
- C. Approved Balancing Agencies.
 - 1. The TAB firm selected shall be from the following list:
 - a. Absolut Balance Company, Inc.; South Lyon, MI.
 - b. Airflow Testing Inc.; Lincoln Park, MI.
 - c. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
 - d. Ener-Tech Testing; Holly, MI.
 - e. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
 - f. International Test & Balance Inc.; Southfield, MI.
- D. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- E. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- F. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.
- G. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- B. Examine system and equipment test reports.
- C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

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- D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- G. Examine strainers for clean screens and proper perforations.
- H. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- J. Examine system pumps to ensure absence of entrained air in the suction piping.
- K. Examine equipment for installation and for properly operating safety interlocks and controls.
- L. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.

- B. Perform the following field tests and inspections to new and renovated portions of duct systems according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.
- C. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

- E. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.
- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling unit components.
- M. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
 - 5. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.

6. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 5. Set system controls so automatic valves are wide open to heat exchangers.
 6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

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1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.
- G. Chilled beams do not require individual hydronic balancing. Verify proper flow is achieved through balancing or control device serving chilled beam control zone. Report discrepancies.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.
- 3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS
- A. Balance variable-flow hydronic systems by following the "Proportional Balancing Procedure" in accordance with NEBB.

- B. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Power factor.
 - 6. Nameplate and measured voltage, each phase.
 - 7. Nameplate and measured amperage, each phase.
 - 8. Starter size.
 - 9. Starter thermal-protection-element rating.
 - 10. Fuse number and size.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.

B. Electric-Heating Coils: Measure the following data for each coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.13 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.14 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the condition of filters.
 4. Check the condition of coils.
 5. Check the operation of the drain pan and condensate drain trap.
 6. Check bearings and other lubricated parts for proper lubrication.

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7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
 2. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 3. Air balance each air outlet.

3.15 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Air handling equipment and outlets: Plus or minus 5 percent.
 - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
 2. Heating-Water Flow Rate: 0 to minus 10 percent.
 3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.16 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems

found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.

- c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
- 13. Notes to explain why certain final data in the body of reports varies from indicated values.
- 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outside, supply, return, and exhaust airflows.
 - 2. Water flow rates.
 - 3. Terminal units.
 - 4. Balancing stations.
- F. Air-Handling Unit - Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 - 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Power factor efficiency.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat coil static-pressure differential in inches wg.
- g. Cooling coil static-pressure differential in inches wg.
- h. Heating coil static-pressure differential in inches wg.
- i. Outside airflow in cfm.
- j. Return airflow in cfm.
- k. Outside-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outside-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Coil identification.
- d. Capacity in Btuh.

- e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm.
 - i. Face area in sq. ft..
 - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
- a. Heat output in Btuh.
 - b. Airflow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
- a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
- a. System and air-handling unit number.

- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft..
- g. Indicated airflow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Test apparatus used.
- d. Area served.
- e. Air-terminal-device make.
- f. Air-terminal-device number from system diagram.
- g. Air-terminal-device type and model number.
- h. Air-terminal-device size.
- i. Air-terminal-device effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in deg F.
- f. Leaving-air temperature in deg F.

- M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Compressor make.
 - e. Compressor model and serial numbers.
2. Test Data (Indicated and Actual Values):
 - a. Inlet-duct static pressure in inches wg.
 - b. Outlet-duct static pressure in inches wg.
 - c. Entering-air, dry-bulb temperature in deg F.
 - d. Leaving-air, dry-bulb temperature in deg F.
 - e. Condenser entering-water temperature in deg F.
 - f. Condenser leaving-water temperature in deg F.
 - g. Condenser-water temperature differential in deg F.
 - h. Condenser entering-water pressure in feet of head or psig.
 - i. Condenser leaving-water pressure in feet of head or psig.
 - j. Condenser-water pressure differential in feet of head or psig.
 - k. Control settings.
 - l. Voltage at each connection.
 - m. Amperage for each phase.
 - n. Kilowatt input.
 - o. Crankcase heater kilowatt.
 - p. Number of fans.
 - q. Condenser fan rpm.
 - r. Condenser fan airflow rate in cfm.
 - s. Condenser fan motor make, frame size, rpm, and horsepower.
 - t. Condenser fan motor voltage at each connection.
 - u. Condenser fan motor amperage for each phase.

- N. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.

- n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Values):
- a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- O. Vibration Measurement Reports:
- 1. Date and time of test.
 - 2. Vibration meter manufacturer, model number, and serial number.
 - 3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
 - 4. Diagram of equipment showing the vibration measurement locations.
 - 5. Measurement readings for each measurement location.
 - 6. Calculate isolator efficiency using measurements taken.
 - 7. Description of predominant vibration source.
- P. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Record the following on the forms:
- 1. Date and time of test. Record each tested location on its own NC curve.
 - 2. Sound meter manufacturer, model number, and serial number.
 - 3. Space location within the building including floor level and room number.
 - 4. Diagram or color photograph of the space showing the measurement location.
 - 5. Time weighting of measurements, either fast or slow.
 - 6. Description of the measured sound: steady, transient, or tonal.
 - 7. Description of predominant sound source.
- Q. Indoor-Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

R. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.18 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

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4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.19 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

****END OF SECTION****

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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 work of this section.
 - B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 "Testing, Adjusting, and Balancing."

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

- A. BAS: Building Automation System
- B. CAD: Computer Aided Design.
- C. DDC: Direct-digital controls.
- D. TC: Temperature Control.

1.4 SYSTEM DESCRIPTION

- A. DDC Temperature Control System consisting of direct digital control system panels, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems. The new temperature controls shall interface with the existing Andover Building Automation System.
- B. BAS/DDC system programming, database and graphic display generation at the existing operator workstation.
- C. Vertical Unit Ventilator DDC Controllers where shown and scheduled on the plans.
- D. Electric and electronic control accessories and other control system devices.

1.5 SEQUENCE OF OPERATION

- A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.6 SUBMITTALS

- A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.
- B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valve and automated dampers shall be incorporated with the complete temperature controls submittal.
- C. 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. Each control device labeled with setting or adjustable range of control
- D. 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.
- E. Shop Drawings:
 - 1. Shop drawings shall be done on CAD. Minimum size 11" x 17".

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2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 4. Details of control panel faces and interior, including controls, instruments, and termination blocks and labeling.
 5. Written sequence of operation for each controlled system.
 6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
 8. Complete bill of materials to identify and quantify all control components
 9. Overall system schematic showing communication trunk cabling to DDC panels, peripheral devices, modems including component locations and wire termination details.
 10. DDC panel layouts showing connected data points and LAN connections. DDC panel terminations including power supply and remote control component termination details shall be provided.
 11. Point list for each DDC panel including point descriptions and addresses. This information may be incorporated with DDC panel layouts.
- F. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
- a. None.
- G. Samples: Temperature sensor cover for each color required and guards if required.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- I. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- J. Project Record Documents: Include the following:
1. Revise Shop Drawings to reflect actual installation and operating sequences.
 2. Record actual locations of control components, including control units and sensors.
 3. Submit the electronic files for all as-built shop drawings on diskette in pdf format.
- K. Software and Firmware Operational Documentation: Include the following:
1. DDC panel keypad operating instructions and DDC panel control override features where applicable.
 2. Device address list.
 3. Program Software Backup: On a magnetic media or compact disc, complete with data files.

- L. Maintenance Manuals: Include the following:
 - 1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
 - 2. Keypad illustrations and step-by-step procedures indexed for each operator function where applicable.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.

1.7 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- D. NEMA DC 3 - Low-Voltage Room Thermostats.
- E. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- F. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
- G. ANSI/ASTM B32 - Solder Metal.
- H. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- I. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
- J. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- 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 NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

- A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
- B. Coordinate location of space temperature sensors and other exposed control sensors with plans and room details before installation.
- C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
- D. Ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
- F. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- G. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.
- H. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

- A. Provide warranty per Division 20 Section "General Mechanical Requirements" and as supplemented in this section.
- B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
- C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.
- D. Provide any software or firmware revisions for controllers provided with project which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 POSTED OPERATING INSTRUCTIONS

- A. Provide panel related as-built documents in protective binder or clear plastic display envelope for each control panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, not including PC Laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

- A. All proprietary manuals and software non-disclosure agreement, where applicable, shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)

- A. The district-wide Andover building automation system (BAS) shall be a fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems.
- B. Microprocessor based DDC panels shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between existing and new DDC panels and each building's existing Network Controller (Andover Controls). Each building's existing Network Controller is connected to the owner's Ethernet and communicates with the owner's existing central BAS server.
- C. Provide i2-Series Controller for VUV under ALT. M1.
- D. DDC panels (controllers) that are currently at i2 level shall be re-used and remain "as is", using the existing Sequence of Operations. Lower revision controllers shall be upgraded to i2 level controllers as shown in contract documents. Provide for any additional sequence of operation changes shown on the Contract Documents that would revise these Sequences. New controllers may mount into the existing back-panels if mounting requirements are met.
- E. Provide BAS front-end PC software upgrades necessary for the upgrade of DDC controllers to i2 level and/or any software upgrade released during the contract period.
- F. Provide revisions to existing graphics to include new work and provide new graphics where required and shown in the Contract Documents. Refer to Section 3.
- G. Approved Manufacturer – System / Installer (Location):
 - 1. Andover Controls Corp. / Mechanical Controls & Maintenance, Inc. aka MCMI (Sterling Heights, MI).

2.2 DDC DATA COMMUNICATIONS NETWORK

- A. Data communication network shall be provided to allow data transmission between all DDC panels and between the DDC panels and the DDC Network Controller.
- B. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network DDC panels. The existing Building Network Controller is connected to the primary network. The secondary sub-networks shall interface with the primary network through the primary network DDC panels. At least one DDC panel connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.

- C. Data communications media shall be twisted pair wires.
- D. The communications network shall allow shared point and control information between DDC panels without dependence on the existing Building Network Controller. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between DDC panels.
- E. Failure of any individual DDC panel shall not cause the loss of communications between peer DDC panels.
- F. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.
- G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.3 DDC NETWORK CONTROLLER (EXPAND EXISTING AS REQUIRED)

- A. Field-verify the existing DDC Network Controller capability for each building, as required to accommodate integration to new HVAC equipment per project scope.
- B. If network controller is near memory capacity, provide a new DDC Network Controller to accommodate integration to new HVAC equipment per project scope.
- C. Provide new network controller (as required) to interface to 3rd party Heating Hot Water and Chilled Water System communication interfaces..

2.4 DDC VUV HEAT PUMP UNIT CONTROLLERS (ALT. M1)

- A. Microprocessor based controllers capable of stand-alone operation for control of Vertical Unit Ventilator (VUV). VUV Controllers shall be networked together and connected to the building's BAS/DDC network. Provide fully functional communication interface ports for communication between VUV controllers and existing Building Network Controller and portable programmer terminal.
- B. Controllers shall work in conjunction with room temperature sensor to provide the sequence of operation as indicated on the drawings. Setpoints shall be adjustable through the portable programmer terminal and BAS.
- C. Controllers shall have electronic outputs compatible with electronic type economizer dampers and relief air damper.
- D. TC contractor shall provide 24 VAC power requirements including transformers unless provided as part of the VUV package. Coordinate with the VUV manufacturer.
- E. If coordinated with mechanical contractor, controllers and damper operators shall be furnished to the VUV manufacturer for factory mounting. Otherwise, controls shall be field installed.
- F. Room temperature sensors for the DDC air terminal unit controllers:

1. Sensing Element: Thermistor or resistance temperature detector (RTD) type. Accuracy shall be +/- 0.5 degrees F over the range of 55 degrees F to 95 degrees F, including calibration error, repeatability, hysteresis, and yearly drift.
2. Cover: Locking type.
3. Provide flat-plate type sensor.
4. Provide insulating base on exterior walls.

2.5 DIRECT DIGITAL CONTROL (DDC) PANELS

- A. Control Panels: Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge protection. DDC panels shall be connected directly to sensors, controlled devices and the communication network.
- B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48 hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.
- C. Provide fully functional communication interface ports for communication between processor, other processors, existing Building Network Controller, portable operator unit and portable programmer terminal.
- D. Panel enclosure shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

2.6 DDC PANEL SOFTWARE

- A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC panel to DDC panel as well as DDC panel to existing Building Network Controller communications, scan inputs and outputs, and contain built-in diagnostics.
- B. Input/output point processing shall include the following:
 1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
 2. Assignment of proper engineering units and status condition identifiers to all points.
 3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.
- C. Command control software shall manage the receipt of commands from the existing Building Network Controller, portable programmer's terminal, and from control programs.
 1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the DDC network, not just within the DDC panel. Delays shall be assignable on an individual per point basis.

2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
 3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
 4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.
- D. Provide self-test procedure. Notify existing Building Network Controller for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.
- E. Provide Alarm Processing:
1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
 2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.
 3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.
 4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.
 5. The capability of automatically initiating commands upon the occurrence of an alarm.
- F. Totalization
1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC panel resident run time limits assignable through the portable programmer's terminal, portable operators unit or the existing Building Network Controller.

2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. Custom DDC Programs

1. All DDC programs shall be fully custom programmable. DDC panels or systems which require remote or factory programming are not acceptable. DDC panels or systems with programs which may not be custom modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
2. Custom DDC programs shall be provided to meet the control strategies as called for in the sequences of operation on the drawings.
3. All DDC setpoints, gains, parameters, time constants, etc., associated with DDC programs shall be available to the operator for display and modification via the existing Building Network Controller and/or portable operators unit.
4. The execution interval of each DDC control loop shall be adjustable from two to 30 seconds.
5. Each DDC panel shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:
 - a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
 - b. Logic: OR, AND, compare, negate.
 - c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
 - d. Data Manipulation: Store, file and set.
 - e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.

2.7 DDC INPUT/OUTPUT SENSORS

A. Current Switches:

1. Split-core donut transformer type for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. Current switches with digital output shall have adjustable trip settings. Field adjust all current switches to trip at approximately 90% of normal motor operating amperage.

3. Manufacturers:

- a. NK Technologies.
- b. Senva.
- c. Setra.
- d. Veris Industries.

B. Temperature Sensors:

- 1. Resistance temperature detectors (RTD) with platinum, nickel or balco element. Accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
- 2. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20° F - 120° F.
- 3. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20° F - 120° F.
- 4. Liquid immersion sensors shall have welded stainless steel thermowell for ferrous pipe, and brass wells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have a calibrated span of 20° F - 120° F. Sensors for heating hot water and domestic hot water application shall have a calibrated span of 100° F - 240° F.
- 5. Room sensors shall have locking cover and a minimum span of 40° F - 90° F. Sensors shall be mounted on extra-large stainless steel back-plate for coverage to eliminate patch/paint issues. Room sensor shall be flat-plate type. Provide insulating base on exterior walls.
- 6. Outside air sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun.
- 7. Manufacturers:
 - a. Specified BAS product where available.
 - b. TCS.
 - c. Minco.
 - d. ACI.
 - e. MAMAC.

C. Outside Air Temperature/Humidity Combination Transmitters:

- 1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.
- 2. Temperature sensor shall be 1000 OHM thin film platinum resistance temperature detector with matching 4-20 mA transmitter having independent zero and span adjustments. Accuracy shall be ± 0.5 degrees F with a range of -25 degrees F to 125 degrees F.

3. Humidity sensor shall be washable thin film type with matching 4-20 mA transmitter having independent zero and span adjustments and linear output over a span of 0-100% RH. Accuracy shall be $\pm 2.5\%$ RH over the range 0-95% RH at 25 degrees C.
4. Manufacturer:
 - a. GE Industrial, Sensing (formerly General Eastern)
 - b. Vaisala.

2.8 THERMOSTATS – ELECTRONIC & ELECTRIC

- A. Electric Low Limit Duct Thermostat (freezestat): Snap acting, auto-reset switch which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, fixed 5 deg F differential, range 30 deg F to 60 deg F, requiring minimum 20 feet length of bulb. Provide one thermostat for every 20 sq. ft. of coil surface. Switch shall be UL listed and rated for 10 amps at 120 VAC. Provide additional switch or contacts for connection to monitoring system.
- B. Strap-on Aquastat: UL listed, with a suitable removable spring clip attaching aquastat to pipe and a snap-acting SPDT switch.
- C. Manufacturers:
 1. Honeywell.
 2. Schneider Electric Controls.
 3. Johnson Controls.

2.9 EMERGENCY POWER-OFF (EPO) PUSH-BUTTON

- A. ADA compliant, pushbutton switch with clear cover to prevent inadvertent closure. Push-to-activate button, two SPDT contacts rated 10 Amps at 120 VAC, and key to re-activate feature.
- B. Manufacturers:
 1. Safety Technology International – model SS-2212PO

2.10 LIMIT SWITCHES

- A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.
- B. Manufacturers:
 1. Allen-Bradley.
 2. General Electric.
 3. Square D.
 4. Westinghouse.
 5. Micro-switch.

2.11 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with DDC Controller and/or relays, devices, and related controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
- B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
- C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.12 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

- A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.
- B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.
- C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).
- D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.
- E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.
- F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.
- G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION - CONTROL SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors and other exposed control sensors with plans and room details before installation. Locate room temperature sensors 48 inches above floor unless noted otherwise.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC panel as the associated output signal.
- E. Provide conduit and electrical wiring where required.

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- F. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.
- G. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.
- H. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- K. Locate, size, and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.
- L. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.
- M. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
- N. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
- O. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.
- P. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.
- Q. Flow meters shall be installed with at least 10 diameters of straight pipe length upstream and five diameters of straight pipe length downstream. Power supply to flow meters shall be 115 VAC from the auxiliary DDC panel, and power connection for each device shall be installed with a lockable local service disconnect. Flow meter transmitters/displays shall be mounted 4 feet above finished floor and shall be located at the DDC panel array unless the maximum available cable length is exceeded. All meter components, including sensors, shall be mounted in accessible locations.

3.2 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

- A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request for Information (RFI) process.
- B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop

drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.

- C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include
 - 1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
 - 2. Graphics generation requirements including special Owner requirements and schedule for completion.
 - 3. Owner training agenda and scheduling.
 - 4. TC/BAS system acceptance procedures.

3.3 IDENTIFICATION AND MARKING

- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.
- B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
- C. Identify each wire as to ID number at each control panel, field device, and splice.
- D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached identifying it as control panel number, system served, area served, fed from receptacle panel number, circuit number, etc.
- E. Temperature control conduit and junction box covers shall be painted Andover INFINET "orange" to signify that it is used for temperature controls. All junction box covers shall be painted orange and the conduit shall be painted with an orange mark (approximately 6 inches long) every 36" to 48", and on both sides of all penetrations.

3.4 GRAPHIC DISPLAY GENERATION

- A. Provide the following graphic displays as a minimum for operator interface to the networked systems, arranged in logical penetration paths. Modify, copy, or expand the existing graphics associated with building as required to allow operator interface to newly installed equipment. Remove graphics associated with equipment that may have been eliminated with project scope of work:
 - 1. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.

2. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
 - a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
 - b. System name.
 - c. Area served.
 - d. Present value or status of all inputs, along with present setpoint.
 - e. Present percent open for each damper, valve, etc. based on commanded position.
 - f. Reset schedule parameters for all points, where applicable.
 - g. Present occupancy mode.
 - h. Present economizer mode, where applicable.
 - i. Present outside air temperature.
 - j. Associated space conditions and setpoints, where applicable.
 - k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
 - l. Color coding to indicate normal and abnormal values, alarms, etc.
3. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc.) shall be provided. Graphic display of output point auto or manual override status shall be provided.
4. Sequence of operation in written (text) format for each HVAC system.
5. Overall BAS system schematic.
6. System management graphic for each network device and/or DDC panel.

3.5 OWNER INSTRUCTION AND TRAINING

- A. Provide a minimum of twenty-four (24) hours of on-site instruction and training to the Owner on the operation of the control systems for the initial installation. Instruction and training hours shall not include travel time to and from the site.
- B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
- C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

3.6 CALIBRATION AND START-UP

- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.7 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

****END OF SECTION****

HYDRONIC PIPING

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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.
 - B. Related Sections include the following:
 - 1. Division 07 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 3. Division 20 Section "Mechanical General Requirements."
 - 4. Division 20 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
 - 5. Division 20 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.

6. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
7. Division 20 Section "Meters and Gages" for thermometers, flow meters, flow measuring devices, and pressure gages.
8. Division 20 Section "Mechanical Identification" for labeling and identifying hydronic piping.
9. Division 23 Section "General-Duty Valves for HVAC" for general-duty gate, globe, ball, butterfly, and check valves.
10. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
11. Division 23 Section "Temperature Controls" for temperature-control valves and sensors.
12. Division 23 Section "Piping Systems Flushing and Chemical Cleaning."
13. Division 23 Section "HVAC Water Treatment."
14. Division 33 Section "Underground Hydronic Distribution Piping" for preinsulated piping systems.

1.2 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride.
- B. HDPE: High density polyethylene.
- C. PP: Polypropylene.
- D. PVC: Polyvinyl chloride.
- E. PTFE: Polytetrafluoroethylene.
- F. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- G. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.3 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, hydronic piping components and installation shall be capable of withstanding the following minimum working pressures and temperatures:
 1. Hot-Water Heating Piping: 125 psig at 200 deg F.
 2. High Temperature Heating Hot Water Piping: 300 psig at 350 deg F.
 3. Chilled-Water Piping: 125 psig at 200 deg F.
 4. Dual-Temperature Heating and Cooling Water Piping: 125 psig at 200 deg F
 5. Heat Pump Loop Piping: 125 psig at 150 deg F.
 6. Condenser-Water Piping: 125 psig at 150 deg F.

7. Glycol Cooling-Water Piping: 125 psig at 150 deg F.
8. Engine Cooling Water Piping: 125 psig at 150 deg F.
9. Condensate-Drain Piping: 150 deg F.
10. Blowdown-Drain Piping: 200 deg F.
11. Air-Vent Piping: 200 deg F.
12. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SYSTEMS DESCRIPTIONS

- A. Hydronic piping system materials are scheduled on the Drawings.
- B. Refer to Application Schedule on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 2. Drain Duty: Hose-end drain valves.

1.5 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. Chemical treatment.
 4. Hydronic specialties.
 5. Plastic pipe and fittings with solvent cement.
- B. Shop Drawings: Detail, at minimum 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation and maintenance manuals.
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. 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.
- B. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.7 EXTRA MATERIALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Socket Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.
- F. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.; Gruvlok Manufacturing; Advanced Copper Method.
 - b. Tyco Fire & Building Products; Grinnell Mechanical Products; Model 672.
 - c. Victaulic Company; Style 606 and Style 607.
 - 2. Grooved-End Copper Fittings: ASTM B 75, 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, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- G. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Apollo Valves; by Conbraco Industries; ApolloXpress.
 - b. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
 - c. NIBCO Inc.; Press System.
 - d. Viega North America; ProPress System.
 2. Housing: Copper.
 3. O-Rings and Pipe Stops: EPDM.
 4. Tools: Manufacturer's special tools.
 5. Maximum 200-psig working-pressure rating at 250 deg F.
- H. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. T-DRILL Industries Inc.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 Steel Pipe: ASTM A 53/A 53M or ASTM A 106, Type E or S, Grade A or B. Include ends matching joining method.
1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, 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, standard pattern.
 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.
 6. Fittings: ASTM A234 ANSI B16.9, steel butt weld to match pipe wall thickness, Class 300.
 7. Flanges: Class 300 forged steel welding neck to match pipe wall thickness and valve flanges, ANSI B16.5. Orifice plate flanges shall be raised face welding neck type with ring joint gaskets and flange taps. Coordinate orifice plate flanges with orifice plate flow elements.

2.3 JOINING MATERIALS

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

2.4 TRANSITION FITTINGS

A. HDPE Plastic-to-Grooved Steel Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.; Gruvlok Manufacturing; Fig. 7307.
 - b. Victaulic Company; Style 997.
2. Ductile iron coupling with integral rows of gripping teeth on the HDPE side of the coupling and conventional key section on grooved side designed to engage standard roll or cut grooved steel pipe.

B. HDPE Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.; Gruvlok Manufacturing; Fig. 7312.
 - b. Victaulic Company; Style 994 Vic-Flange.
2. Ductile iron flange adapter having integral gasket and designed to permit direct connection of ANSI Class 125 and 150 steel or bronze flanged components into HDPE systems.

2.5 VALVES

- ### A. General Service Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC."

2.6 SPECIALTY VALVES

A. Balance Valves:

1. Balance Valves NPS 6 and Larger: Lug type butterfly valves with aluminum bronze disc, AISI 300 Series stainless steel stem, resilient replaceable seat for service at not less than 250 deg F and memory stops. Refer to Division 23 Section "General-Duty Valves for HVAC" for additional requirements.
 - a. Provide lubricated enclosed screw or worm gear operator with handwheel for sizes 6 inches and larger.
 - b. Pressure rating shall meet or exceed system minimum pressure rating.
2. Flow Measuring: Use Flow Measuring Devices as specified in Division 20 Section "Meters and Gages."
3. Balance Valves for Sizes Less than NPS 6 Combination balance valve and flow measuring device as specified in this Section.

B. Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi).
 - c. Nexus Valve.
 - d. PRO Hydronic Specialties, LLC.
 - e. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
2. Body: Brass or 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. WOG Rating: Minimum 400 psig.
10. Maximum Operating Temperature: 250 deg F.
- C. Combination, Balancing Valves and Flow Measuring Devices NPS 2-1/2 through NSP 4:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi).
 - c. Nexus Valve.
 - d. PRO Hydronic Specialties, LLC.
 - e. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
 2. Body: Cast-iron or steel body, ball, plug, or butterfly pattern with calibrated orifice or venturi.
 3. Stem Seals: EPDM O-rings.
 4. Disc: Glass and carbon-filled PTFE.
 5. Seat: PTFE.
 6. End Connections: Flanged or grooved.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. WOG Rating: Minimum 200 psig.

10. Maximum Operating Temperature: 225 deg F.
- D. Contractor Option for Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller: Preassembled coil hook up kits may be used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi).
 - c. Nexus Valve.
 - d. PRO Hydronic Specialties, LLC.
 - e. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
- E. Diaphragm-Operated, Pressure-Reducing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Apollo Valves; by Conbraco Industries, Inc.
 - d. Bell & Gossett; Xylem Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 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. Valve Seat and Stem: Noncorrosive.
 9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- F. Diaphragm-Operated Safety Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Anderson Greenwood & Co.; Kunkle Valve Division.
 - c. Armstrong Pumps, Inc.
 - d. Apollo Valves; by Conbraco Industries, Inc.
 - e. Bell & Gossett; Xylem Inc.
 - f. Spence Engineering Company, Inc.

- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 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. Valve Seat and Stem: Noncorrosive.
 - 9. 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.
- G. Automatic Flow-Control Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. PRO Hydronic Specialties, LLC.
 - 2. Body: Brass or ferrous metal.
 - 3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
 - 4. Combination Assemblies: Include bronze or brass-alloy ball valve.
 - 5. Identification Tag: Marked with zone identification, valve number, and flow rate.
 - 6. Size: Same as pipe in which installed.
 - 7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
 - 8. Minimum Pressure Rating: 300 psig.
 - 9. Maximum Operating Temperature: 250 deg F.

2.7 CONTROL VALVES

- A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Temperature Controls."
- B. Calibrated orifice balancing valves shall not be required on devices where pressure independent characterized control valves (PICCV's) are installed.

2.8 AIR CONTROL DEVICES

- A. Manual Air Vents: Use ball-valve-type hose-end drain valves, refer to Division 20 Section "Valves."
- B. Automatic Air Vents:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Spirotherm, 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.
 - 6. Discharge Connection: NPS 1/4.
 - 7. Maximum Operating Pressure: 150 psig.
 - 8. Maximum Operating Temperature: 240 deg F.
- C. Diaphragm-Type Expansion Tanks:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - 2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 3. Diaphragm: 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.
- D. Combination Air and Dirt Separators:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Spirotherm, Inc.; VDN Series.

2. Body: Fabricated steel; constructed for 150-psig maximum working pressure and 250 deg F maximum operating temperature. Separator shall have body extended below pipe connections for dirt separation and include removable lower head.
3. Air and Dirt Separation Mechanism: Internal copper core tube with continuous wound copper medium permanently attached followed by continuous wound copper wire permanently affixed.
4. Venting Chamber: With integral full port, float actuated brass venting mechanism. Include valved side tap to flush floating dirt or liquids and for quick bleeding of air during system fill.
5. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded.
7. Size: Match system flow capacity.

2.9 STEEL, HYDRONIC BUFFER TANKS

A. Manufacturers:

1. Adamson Global Technology Corporation.
2. Armstrong Pumps, Inc.
3. Cemline Corporation.
4. Highland Tank & Mfg. Co.
5. Taco, Inc.

B. Description: Steel, vertical pressure-rated tank with cylindrical sidewalls.

C. Construction: ASME code, steel, constructed with nontoxic welded joints, for 125-psig working pressure, and internal baffle to prevent short circuiting.

D. Connections and Tappings: Factory-fabricated steel, welded to tank before testing and labeling.

1. NPS 2 and Smaller: ASME B1.20.1, with female thread.
2. NPS 2-1/2 and Larger: ASME B16.5, flanged.

E. Include connections and tappings for the following:

1. Inlet.
2. Outlet.
3. Factory mounted air vent.

F. Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling.

G. Exterior Coating: Primer paint and factory installed 1/2-inch thick elastomeric thermal insulation.

2.10 HYDRONIC PIPING SPECIALTIES

- ### A. Diverting Fittings: 125-psig working pressure; 250 deg F maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.

- B. Flexible connectors and expansion fittings are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

2.11 HYDRONIC PIPING STRAINERS

A. Manufacturers:

1. Keckley.
2. Metraflex.
3. Mueller Steam Specialty.
4. Nibco, Inc.
5. Spence.
6. Sure Flow Equipment Inc.
7. Watts Water Technologies, Inc.
8. Yarway.
9. Anvil International, Inc.; Gruvlok Manufacturing (for grooved piping).
10. Tyco Fire & Building Products, Grinnell Mechanical Products (for grooved piping)
11. Victaulic Company; (for grooved piping).

B. Y-Pattern Strainers, Bronze:

1. CWP: 200 psig minimum, unless otherwise indicated.
2. SWP: 125 psig minimum, unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller.
4. End Connections: Threaded or soldered.
5. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
6. Drain:
 - a. Pipe plug for sizes NPS 2 and smaller.
 - b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

C. Y-Pattern Strainers, Cast and Ductile Iron:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger; grooved ends may be used on grooved piping.

3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain:
 - a. Pipe plug for sizes NPS 2 and smaller.
 - b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

D. Basket Strainers, Cast Iron:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain: Factory-installed, hose-end drain valve.

2.12 STAINLESS STEEL STRAINERS

A. Manufacturers:

1. Keckley.
2. Metraflex.
3. Mueller Steam Specialty.
4. Nibco, Inc.
5. Spence.
6. Sure Flow Equipment Inc.
7. Watts Water Technologies, Inc.
8. Yarway.

B. Y-Pattern Strainers:

1. Body: ASTM A 351, Type 316 stainless steel, with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. SWP Rating: 250-psig steam working pressure.

C. Basket Strainers:

1. Body: ASTM A 351, Type 316 stainless steel, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. SWP Rating: 250-psig steam working pressure.

2.13 CHEMICAL TREATMENT

- A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. 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.
- B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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 Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.

- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping, other than drain piping, at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee 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.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC."
- Q. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- R. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- S. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- T. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- U. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.
- V. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- W. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- X. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and where indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

- Y. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
- Z. Identify piping as specified in Division 20 Section "Mechanical Identification."

3.2 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 20 Section "Hangers and Supports." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet 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.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 - 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 - 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 - 10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 - 11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
 - 12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
 - 13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.

14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 7. NPS 4 to NPS 5: Maximum span, 10 feet minimum rod size, 1/2-inch.
 8. NPS 6: Maximum span, 10 feet minimum rod size, 5/8-inch.
 9. NPS 8: Maximum span, 10 feet minimum rod size, 3/4-inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.3 PIPE JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 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. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Glycol Systems:
 1. Install automatic air vents on expansion tanks and install high capacity automatic air vents on air separators. Route vent piping to spill over glycol fill station.
 2. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- D. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- E. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4

bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

- G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.5 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 ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 20 Section "Meters and Gages."

3.6 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.

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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 "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 2 hours, 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. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Remove disposal fine-mesh strainers in pump suction diffusers.
 4. Set makeup pressure-reducing valves for required system pressure.
 5. 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).
 6. Set temperature controls so all coils are calling for full flow.
 7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 8. Verify lubrication of motors and bearings.

****END OF SECTION****

METAL DUCTS

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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.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 23 Section "Nonmetal Ducts" for fabric ducts, fibrous-glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
 4. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems in pressure classes from minus 6- to plus 6-inch wg.
- B. Products Installed but Not Furnished Under This Section:
 - 1. Terminal boxes which are to be furnished by the Laboratory Airflow Controls Contractor shall be installed by the Mechanical Contractor. Refer to Division 23 Section "Laboratory Airflow Controls."

1.3 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.
- E. FRP: Fiberglass-reinforced plastic.
- F. PVC: Polyvinyl Chloride.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 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 performance requirements and design criteria indicated in "Duct Application Schedule" Article.

1.6 SUBMITTALS

- A. Shop Drawings: Drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Duct layout indicating sizes and pressure classes.
 - 3. Elevations of top and bottom of ducts.
 - 4. Dimensions of main duct runs from building grid lines.

5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

B. 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.

C. Coordination Drawings: Reflected ceiling plans, 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. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Welding certificates.

E. Field quality-control test reports.

1.7 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 D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

- 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.

1.8 COORDINATION

- A. Sheet metal trades shall cooperate fully with the Laboratory Airflow Controls Trades and shall attend all field installation training sessions.
- B. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

- C. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 coating designation. Factory-applied PVC coatings shall be 4 mils thick on exterior sheet metal surfaces of ducts and fittings exposed to corrosive conditions and minimum 1 mil thick on interior surfaces.
- D. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 coating designation. Factory-applied PVC coatings shall be 4 mils thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 4 mils thick on opposite surfaces.
- E. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 coating designation. Factory-applied

PVC coatings shall be 4 mils thick on interior sheet metal surfaces of ducts and fittings exposed to corrosive conditions and minimum 1 mil thick on exterior surfaces.

- F. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- G. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.
- H. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- I. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- J. Tie Rods: For rectangular ducts having a side dimension of 48 inches or greater. Galvanized steel, 3/8-inch minimum diameter.

2.3 DUCT LINER

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
 - 1. Manufacturers:
 - a. CertainTeed Corp.; Insulation Group.
 - b. Johns Manville International, Inc.
 - c. Knauf Fiber Glass GmbH.
 - 2. Materials: ASTM C 1071, Type I, flexible; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
 - a. Thickness: [1 inch] [1-1/2 inches] [2 inches].
 - b. Density: 1-1/2 pounds per cubic foot.
 - c. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - e. Maximum Operating Temperature: 250 deg F when tested according to ASTM C 411.
 - f. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - g. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - 1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
 - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
 - 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
 - 3. Noise reduction coefficient (NRC): Sound absorption coefficients shall not be less than those in the table below as tested by ASTM C423 using an ASTM E795 Type A mounting.

		Sound absorption coefficients at octave band center frequencies, Hz						
Thickness Inches (mm)		125	250	500	1000	2000	4000	NRC
1	(25)	.08	.31	.59	.84	.91	.90	.70
1-1/2	(38)	.10	.47	.83	.93	.97	.96	.80
2	(51)	.24	.64	.96	1.03	1.00	.99	.90

2.4 SEALANTS 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 according to UL 723; certified by an NRTL.
- B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
 1. Manufacturers:
 - a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.
- C. Water-Based Joint and Seam Sealant:
 1. Manufacturers:
 - a. Hardcast; Flex-Grip 550 and Versa-Grip 181.
 - b. Polymer Adhesives; No. 11.
 - c. United McGill.
 2. Application Method: Brush on.
 3. Solids Content: Minimum 65 percent.
 4. Shore A Hardness: Minimum 20.
 5. Water resistant.
 6. Mold and mildew resistant.
 7. VOC: Maximum 75 g/L (less water).
 8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 9. Service: Indoor or outdoor.
 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 1. Manufacturers:
 - a. Hardcast; Sure-Grip 404.
 - b. United McGill.

2. Application Method: Brush on.
 3. Base: Synthetic rubber resin.
 4. Solvent: Toluene and heptane.
 5. Solids Content: Minimum 60 percent.
 6. Shore A Hardness: Minimum 60.
 7. Water resistant.
 8. Mold and mildew resistant.
 9. VOC: Maximum 395 g/L.
 10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 11. Service: Indoor or outdoor.
 12. Substrate: Compatible with galvanized sheet steel, 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. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.
- 2.5 HANGERS AND SUPPORTS
- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
 4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
- E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
 - a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 - b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
 2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
 3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
 4. Manufacturers:
 - a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - b. Duro Dyne Corp.; Dyna-Tite System.
 - c. Gripple Inc.; Hang-Fast System.
- F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
 - a. Stainless steel complying with ASTM A 492.
 2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
 3. End Fixings:

- a. Loop End: Type 316L/A4 stainless steel.
 - b. Stud or Toggle End: Type 304L/A2 stainless steel.
 - c. Plain end suitable for stainless steel wire rope beam clamp.
4. Manufacturers:
- a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - b. Duro Dyne Corp.; Dyna-Tite System.
 - c. Gripple Inc.; Hang-Fast System.
- G. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.

2.6 ROOF MOUNTED DUCT SUPPORTS

- A. General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted duct.
- B. Support: Assembly of bases, and vertical and horizontal members, for roof installation without membrane penetration.
1. Manufacturer:
- a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. ERICO/Michigan Hanger Co.
 - c. MIRO Industries.
 - d. Portable Pipe Hangers.
2. Bases: Two or more plastic, stainless steel, or recycled rubber.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.

2.7 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
3. Internal Tie Rod: Ducts having a side dimension of 48 inches or greater only.
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
- a. Ductmate Industries, Inc.

- b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.8 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - 1. Fan discharges.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.
- H. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - 1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- I. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.9 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round and Flat-Oval, Spiral Lock-Seam Ducts:
 - 1. Manufacturers:

- a. Eastern Sheet Metal (ESM).
 - b. LaPine Metal Products.
 - c. Lindab Inc.
 - d. McGill AirFlow Corporation.
 - e. SEMCO Incorporated.
 - f. SET Duct Manufacturing, Inc.
 - g. Tangent Air, Inc.
 - h. Universal Spiral Air.
- C. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
 1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- D. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
 1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- E. Duct Joints:
 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
 4. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
 5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - a. Manufacturers:
 - 1) AccuDuct Mfg. Inc.
 - 2) Ductmate Industries, Inc.
 - 3) Eastern Sheet Metal (ESM).
 - 4) Lindab Inc.
 - 5) Universal Spiral Air.
 6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
 - a. Manufacturers:
 - 1) AccuDuct Mfg. Inc.

- 2) Ductmate Industries, Inc.
- 3) Eastern Sheet Metal (ESM).
- 4) McGill AirFlow Corporation.
- 5) SEMCO Incorporated.
- 6) Universal Spiral Air.

- F. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
 2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- G. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)
1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
 2. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
 3. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
 4. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- H. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- I. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- J. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
 - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
 - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
 - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
 - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
 - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

2.10 DOUBLE-WALL DUCT AND FITTING FABRICATION

A. Manufacturers:

1. Eastern Sheet Metal (ESM).
2. LaPine Metal Products.
3. Lindab Inc.
4. McGill AirFlow Corporation.
5. SEMCO Incorporated.
6. SET Duct Manufacturing, Inc.

7. Tangent Air Inc.
 8. Universal Spiral Air.
- B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
 2. Insulation: 1-inch- thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
 - a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:
 - a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.
 - b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
 - c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
 - d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.
 4. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.
 - a. Provide 1 mil mylar liner between acoustical insulation and perforated inner liner.
 5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.
- C. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Inner Ducts: Use the following sheet metal thicknesses:
 - a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
 - b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
 - c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
 2. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.

PART 3 - EXECUTION

3.1 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.2 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.3 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
- O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
 - 1. Intermediate level.

3.4 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 the 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.

3.5 DUCT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.
 - 1. Seal Class: Refer to Application Schedule on the Drawings.
 - 2. Seal ducts before external insulation is applied.
 - 3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.6 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install concrete inserts before placing concrete.
- D. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.
- E. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- F. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.
- G. Use load rated cable suspension system for round duct in exposed locations.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 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 Division 09 painting Sections.

3.9 FIELD QUALITY CONTROL

A. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

B. Duct system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

****END OF SECTION****

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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.
 - B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Testing, Adjusting, and Balancing" for duct test holes.
 - 3. Division 23 Section "Temperature Controls" for motorized control dampers.
 - 4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.2 DEFINITIONS

- A. NVLAP: National Voluntary Laboratory Accreditation Program.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For turning vanes, include data for pressure loss generated sound power levels.
 - 2. For duct silencers, include pressure drop and dynamic insertion loss data.
- B. 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. Duct security bars.
 - f. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed for each temperature rating.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
- H. Tie Rods: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches for use in ducts in humid or corrosive atmospheres.
- I. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. American Warming and Ventilating.
 2. Greenheck.
 3. Ruskin Company.
- B. Description: Multiple-blade, parallel action counterbalanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

- C. Performance: Based on tests in accordance with AMCA Standard 500:
 - 1. Pressure drop not to exceed 0.15 inch wg at face velocity of 2500 fpm.
 - 2. Leakage not to exceed 9.2 cfm per square foot at 1 inch wg differential and temperature of 70 deg F.
 - D. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
 - E. Blades: 0.025-inch- thick, roll-formed aluminum or 0.050-inch- thick aluminum sheet.
 - F. Blade Seals: Manufacturer's standard seal material.
 - G. Blade Axles: Nonferrous or galvanized steel.
 - H. Tie Bars and Brackets: Aluminum or galvanized steel.
- 2.4 LOW PRESSURE MANUAL VOLUME DAMPERS
- A. Manufacturers:
 - 1. American Warming and Ventilating.
 - 2. Arrow United Industries.
 - 3. Greenheck.
 - 4. Krueger.
 - 5. Louvers and Dampers.
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Company, Inc.
 - 9. Young Regulator Company.
 - B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
 - C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
 - D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- F. Damper Materials:
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 - 5. Tie Bars and Brackets: Galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 MEDIUM OR HIGH PRESSURE MANUAL VOLUME DAMPERS

- A. Manufacturers:
 - 1. American Warming and Ventilating.
 - 2. Greenheck.
 - 3. Louvers and Dampers.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
 - 6. Vent Products Company, Inc.
- B. General Description: Factory fabricated, galvanized steel or extruded aluminum construction, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.
- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade, or multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff,

and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.

- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.
- F. Damper Materials:
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 4. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - 5. Blade Axles: Galvanized steel or stainless steel.
 - 6. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 - 7. Tie Bars and Brackets: Aluminum or galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.6 LOW LEAKAGE MANUAL VOLUME DAMPERS

- A. Low-Leakage, Steel, Manual Volume Dampers:
 - 1. Manufacturers:
 - a. American Warming and Ventilating.
 - b. Greenheck.
 - c. Louvers and Dampers; a division of Mestek, Inc.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
 - f. Vent Products Company, Inc.
 - 2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Angle shaped.
 - b. Galvanized-steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch thick.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Blade Seals: Neoprene.
 9. Jamb Seals: Cambered aluminum.
 10. Tie Bars and Brackets: Galvanized steel.
 11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- B. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Manufacturers:
 - a. American Warming and Ventilating.
 - b. Greenheck.
 - c. Louvers and Dampers; a division of Mestek, Inc.
 - d. Nailor Industries Inc.
 - e. Ruskin Company.
 - f. Vent Products Company, Inc.
 2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Angle-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
 - a. Multiple or single blade.
 - b. Opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:

1. Size: 1-inch 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- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.7 MANUAL VOLUME DAMPERS (IRIS STYLE)

A. Manufacturers:

1. Continental Fan Manufacturing, Inc.; IRIS Series.
2. Fantech; Systemair Group; IR Series.
3. Ruskin Company; VFBD35.

- B. Description: Round manual volume damper complete with pressure ports, constructed of galvanized steel, fitted with a neoprene gasket, and using interlocking steel plates and calibrated control lever to form an adjustable aperture.

2.8 MOTORIZED CONTROL DAMPERS

- A. Refer to Division 23 Section "Temperature Controls."

2.9 BLAST GATES

- A. Manufacturers:

1. Dixie Sheet Metal.
2. LaPine Metal Products.
3. Semco.

- B. Full-body style, factory fabricated of minimum 18 gage, galvanized sheet metal.

2.10 FIRE DAMPERS (CURTAIN STYLE)

- A. Manufacturers:

1. Air Balance, Inc.
2. Greenheck.
3. NCA Manufacturing, Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

- B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.

- C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

- D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- H. Fusible Links: Replaceable, 165 deg F rated.

2.11 FIRE DAMPERS (MULTIPLE BLADE TYPE)

- A. Manufacturers:
 - 1. Greenheck.
 - 2. NCA Manufacturing, Inc.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. Dynamic fire dampers with multiple blades, and labeled according to UL 555, maximum velocity of 2000 fpm, maximum static pressure 4 inches w.g.
- C. Fire Rating:
 - 1. 1-1/2 hours for 2 hour rated walls.
 - 2. 3 hours for 4 hour rated walls.
- D. Frame: Fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Parallel operation, single-piece airfoil type construction with 0.078 inch equivalent thickness, or 0.064 inch thick, roll-formed, triple v-groove.
- H. Axles: 1/2 inch plated steel hex.
- I. Bearings: Stainless steel, or oil-impregnated bronze sleeve type, pressed into frame.
- J. Linkage: Concealed in frame.
- K. Fusible Links: Replaceable, 165 deg F rated.

2.12 SMOKE DAMPERS

- A. Manufacturers:

1. Air Balance, Inc.
 2. Greenheck.
 3. Nailor Industries Inc.
 4. NCA Manufacturing, Inc.
 5. Ruskin Company.
- B. General Description: Smoke dampers with airfoil blades, labeled according to UL 555S, with minimum Class II leakage rating.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame and Blades: 16 gage, galvanized sheet steel.
- E. Mounting Sleeve: Factory-installed, galvanized sheet steel.
1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Damper Actuators: Electric modulating or two-position action as required.
1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 2. Size for torque required for damper seal at load conditions.
 3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 4. 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.
 5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac.
 6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
 7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
 8. Actuator timing shall meet 15 sec.
 9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.
- H. Damper Actuators: Pneumatic modulating or two-position action.

1. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing.
2. 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.
3. Actuator Degradation Temperature: Not to exceed 250 deg F .
- I. Damper blade position end switches: Factory installed damper position switch package for both full open and full closed indication (equivalent to Ruskin SP100 switch package).
- J. Test Switch: Damper Remote mounted momentary "test" push-button mounted 3-position "normal/closed/override" toggle switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.
 1. For pneumatic actuators, include factory installed electric/pneumatic (EP) switch for testing function.
 2. Include damper remote mounted "open" and "closed" indication lights on switch plate for connection to factory installed damper blade position end switches.

2.13 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 1. Air Balance, Inc.
 2. Greenheck.
 3. Nailor Industries Inc.
 4. NCA Manufacturing, Inc.
 5. Ruskin Company.
- B. General Description: Combination fire and smoke dampers shall be labeled according to UL 555 and UL 555S. Leakage shall not exceed 10 cfm per square foot at 1 inch WG differential pressure (Leakage Class II).
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating:
 1. 1-1/2 hours for 2 hour rated walls.
 2. 3 hours for 4 hour rated walls.
- E. Smoke Detector: Integral, factory wired for single-point connection.
- F. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.
- G. Mounting Sleeve: Factory-installed, galvanized sheet steel.
 1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

- H. Rated pressure and velocity to exceed design airflow conditions.
- I. Damper Actuators: Electric modulating or two-position action as required.
 - 1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 2. Size for torque required for damper seal at load conditions.
 - 3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 - 4. 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.
 - 5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac.
 - 6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
 - 7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
 - 8. Actuator timing shall meet 15 sec.
 - 9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.
- J. Damper Actuators: Pneumatic modulating or two-position action.
 - 1. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing.
 - 2. 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.
 - 3. Actuator Degradation Temperature: Not to exceed 250 deg F.
- K. Manual Heat Responsive Fuse Link with Reset and Damper Blade Position End Switches: Factory installed manual heat responsive fuse link with reset switch / damper position switch package for both full open and full closed indication (equivalent to Ruskin TS150 switch package).
- L. Test Switch: Damper Remote mounted momentary "test" push-button mounted 3-position "normal/closed/override" toggle switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.
 - 1. Include damper remote mounted "open" and "closed" indication lights on switch plate for connection to factory installed damper blade position end switches.

2.14 TURNING VANES

A. Manufactured Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
4. Manufacturers:
 - a. Aero/Dyne Company; H-E-P Turning Vanes.
 - b. Ductmate Industries, Inc.
 - c. Duro Dyne Corp.
 - d. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Acoustic Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
3. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2.15 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:
 - a. Air Balance, Inc.
 - b. Greenheck.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two compression locks.

- c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Flexmaster U.S.A., Inc.
 - 2. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.16 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.17 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. ADSCO Manufacturing LLC.
 - 2. Duro Dyne Corp.
 - 3. Senior Flexonics Pathway.
 - 4. Ventfabrics, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- E. 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..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..
 - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd..
 - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.

2.18 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

- A. Manufacturers:
 - 1. Flexmaster Type 8M, UL 181, Class 1.
 - 2. Automation Industries Thermaflex.
 - 3. Hart & Cooley.
- B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.
- C. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F .

- D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

- E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
- F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.19 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Manufacturer:
- Automation Industries Thermaflex; FlexFlow Elbow.
 - Smart Air & Energy Solutions; SMART Flow Elbow.
- B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.
- C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.20 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.21 FINISHES

- A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 - EXECUTION

3.1 APPLICATION AND 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. Provide 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 PVC coated ducts; and aluminum accessories in aluminum ducts.
- C. 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 in ducts with liner in a manner that avoids damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Install fire and smoke dampers according to UL listing.
- G. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- H. Install duct silencers rigidly to ducts.
- 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 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. Control devices requiring inspection.
 - 8. Elsewhere as indicated.

- J. Install access doors with swing against duct static pressure.
- K. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.
- L. Install pressure relief doors vertically and level in accordance with manufacturer's instructions, between the fan and first operable damper.
- M. Label access doors according to Division 20 Section "Mechanical Identification."
- N. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- O. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- Q. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands.
- S. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- T. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
 - 1. Use manufactured double-vane turning vanes unless otherwise specified.
 - 2. Seat outboard-most vane in heel of duct elbow.
 - 3. Provide vanes for all runner punchings, practice of eliminating every other vane is prohibited.
 - 4. Use single-vane turning vanes in low pressure square elbows.

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.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

DIFFUSERS, REGISTERS, AND GRILLES

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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. Related Sections include the following:
 1. Division 10 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 2. Division 20 Section "Mechanical General Requirements."
 3. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each 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.
- B. Coordination Drawings: Reflected ceiling plans, 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. Ceiling suspension assembly members.
 2. Method of attaching hangers to building structure.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 5. Duct access panels.

PART 2 - PRODUCTS

2.1 AIR DIFFUSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Anemostat; a Mestek Company.
 - 2. Krueger; Tomkins PLC.
 - 3. Nailor Industries of Texas Inc.
 - 4. Price Industries.
 - 5. Titus; Tomkins PLC.
 - 6. Tuttle & Bailey; Tomkins PLC.
- B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.
- C. Provide plaster frames for units installed in plaster ceilings.
- D. Provide gaskets for supply terminal air devices mounted in finished surfaces.
- E. Air diffusion devices shall be standard off white baked enamel finish unless noted otherwise. Provide air diffusion device interior surfaces, including blank-offs, with black matte finish.
- F. Air pattern adjustments shall be made from the face of the device.
- G. Refer to drawings and schedules for quantities, types, and finishes.
- H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.2 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."
- B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."

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.

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- 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 practicable. 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. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.
- D. 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****

HEATING AND COOLING COILS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Sections for coils that are integral to air-handling units.

1.2 SUMMARY

- A. This Section includes duct-mounted heating coils, and heating coils that are an integral part of air-handling units.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each coil. Include rated capacity and pressure drop for each coil.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance:

1. Comply with ASHRAE 33 for methods of testing heating coils.

PART 2 - PRODUCTS

2.1 WATER COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Aerofin Corporation.
 2. Carrier; a United Technologies Company.
 3. Daikin Applied; a member of Daikin Industries, Ltd.
 4. JCI/York International.
 5. Luvata/Heatcraft Commercial/Industrial Products.
 6. Precision Coils; a business of Unison Comfort Technologies.
 7. Trane Inc.; a Division of Ingersoll Rand.
- B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.024 inch wall thickness, and minimum 0.50 inch diameter.
- F. Fins: Aluminum, minimum 0.010 inch thick.
- G. Headers: Cast iron with cleaning plugs, and drain and air vent tappings or seamless copper tube with brazed joints, prime coated.
- H. Frames, Hot Water Coils: Galvanized-steel channel frame, minimum 0.0625 inch thick for flanged mounting.
- I. Frames, Chilled Water Coils: ASTM A 666, Type 304 stainless steel, minimum 0.0625 inch thick for flanged mounting.
- J. Coating: Heresite P-403 baked phenolic for coils installed in stainless steel ductwork.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Laboratory Terminal Unit Hot Water Coils: Caulk and seal frame and all housing tube openings in the field with a non-hardening sealant. Sealant type shall be approved by the coil manufacturer.
- D. Straighten bent fins on air coils.
- E. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Temperature Controls," and other piping specialties are specified in Division 23 Section "Hydronic Piping."
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

****END OF SECTION****

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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 work of this section.
- 1.2 SUMMARY
 - A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.
- 1.3 REFERENCES
 - A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. A.N.S.I. American National Standards Institute
2. A.S.T.M. American Society for Testing Materials
3. I.C.E.A. Insulated Cable Engineers Association
4. I.E.E.E. Institute of Electrical and Electronics Engineers
5. N.E.C. National Electrical Code
6. N.E.C.A National Electrical Contractors Association
7. N.E.M.A.National Electrical Manufacturer's Association
8. U.L.Underwriters Laboratories, Inc.
9. N.E.C.A. 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."

1.4 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
 1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
- C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

1.5 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all

current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items and all utilities costs in proposal.

- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.6 DRAWINGS

- A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.7 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

1.8 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.9 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

- A. Submit project-specific submittals for review in compliance with Division 1.
- B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- C. Provide detailed layout shop Drawings (on transparent media) of all lighting and power distribution systems, routing of conduits, combining of circuits, circuiting, details and related information necessary of installation and maintenance. After review by the Architect/Engineer, a copy of Drawings will be stamped and returned to the Contractor.
- D. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.
- E. Submit for approval shop drawings for all electrical systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures). Refer to other sections of the electrical Specifications for additional requirements.

Wiring Devices
Lighting Fixtures
Occupancy Sensors (material and lay-out drawings)
Clocks
Fire Alarm Systems
Sound Systems

1.11 COORDINATION DRAWINGS

- A. Submit project specified coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 1 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for Owner and shall be bound in ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
- C. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
 - 1. Routine maintenance procedures.
 - 2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
 - 3. Trouble-shooting procedures.
 - 4. Contractor's telephone numbers for warranty repair service.
 - 5. Submittals.
 - 6. Recommended spare parts lists.
 - 7. Names and telephone numbers of major material suppliers and subcontractors.
 - 8. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 1.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or mylar which have been neatly marked to represent as-built conditions for all new electrical work.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
- D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

- A. Warranty: Comply with the requirements in Division 1 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:
 - 1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

3.2 DEMOLITION WORK

- A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, electrical equipment, devices, lighting fixtures, conduit, and wiring called out on the Drawings and as necessary whether such

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items are actually indicated on the Drawings or not in order to accomplish the installation of the specified new work.

- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.
- E. Reroute signal wires, lighting and power wiring as required to maintain service. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or at the panels.
- F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.
- G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where approved by the Architect/Engineer.
- H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, relamped and reconditioned suitable for satisfactory operation and appearance.

3.3 TEMPORARY SERVICES

- A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 1, a complete temporary electrical and telephone service during construction.

3.4 CHASES AND RECESSES

- A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.5 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.6 EXCAVATION AND BACKFILLING

- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.
- B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.
- C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- D. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling.

3.7 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, motors, lighting fixtures, and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.8 CLEANING

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.9 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.10 EXTRA WORK

- A. For any extra electrical work which may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

Prior to any extra work which may be proposed, the Electrical Contractor shall submit unit prices (same prices for increase/decrease of work) for the following items: 1/2", 3/4", 1", 1-1/2" conduit; #12, #10, #8, #6, #2 wire; receptacle, I.G. receptacle, data box, fire alarm horn/strobe, fire alarm strobe, P.A. speaker, clock, or other devices which may be required for any proposed extra work.

3.11 DRAWINGS AND MEASUREMENTS

- A. These Specifications and accompanying Drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if call for by both. The Contractor understands that the work herein described shall be complete in every detail.
- B. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

****END OF SECTION****

BASIC ELECTRICAL MATERIALS AND METHODS

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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. Electrical equipment coordination and installation.
 2. Sleeves for raceways and cables.
 3. Sleeve seals.
 4. Common electrical and communications installation requirements.
 5. Grout.
- 1.3 DEFINITIONS
 - A. ATS: Acceptance Testing Specifications.
 - B. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - C. NBR: Acrylonitrile-butadiene rubber.
- 1.4 SUBMITTALS
 - A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

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 and provide access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 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.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.3 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers:
 - 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: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL AND COMMUNICATIONS 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 raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS 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. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
- C. 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.

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- 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 sleeve seal is to be installed or unless seismic criteria require a different clearance.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
 - 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. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- 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 Division 7 Section "Through-Penetration Firestop Systems."
- 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 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 "wall pipes" for 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 underground, 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.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.5 FIELD QUALITY CONTROL

- A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION

CONDUCTORS AND CABLES

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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 building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B. Related Sections include the following:
 - 1. Division 26 Section "Control/Signal Transmission Media" for transmission media used for control and signal circuits.
 - 2. Division 26 Section "Electrical Identification" for conductor and cable color-coding.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association 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.

- B. 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.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

- A. Manufacturers, Copper:
 - 1. Triangle.
 - 2. Royal.
 - 3. Rome.
 - 4. General Cable Corporation.
 - 5. Southwire Company.
 - 6. Draka USA.
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- C. Conductor Material: Copper.
- D. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- E. Conductor Insulation Types: Type THHN-THWN and XHHW complying with NEMA WC 70.
- F. Multiconductor Cable: Metal-clad cable, Type MC with ground wire.

2.3 CONNECTORS AND SPLICES

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. AMP Incorporated/Tyco International.
 - 3. Hubbell/Anderson.
 - 4. O-Z/Gedney; EGS Electrical Group LLC.

5. 3M Company; Electrical Products Division.
 6. T & B.
 7. Burndy.
 8. ILSCO.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Exposed Feeders #4/0 and larger: Type XHHW, single conductor in raceway.
- D. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- E. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway and metal-clad cable, Type MC, for branch circuit drops to devices and within partition walls. MC cable shall not be run in ceiling space in lengths greater than 6'-0".
- H. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- I. Underground Feeders and Branch Circuits: XHHW single conductors in conduit.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- K. Fire Alarm Circuits: Type THHN-THWN, in raceway or Power-limited, fire-protective, signaling circuit cable.
- L. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- M. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- N. Critical Fire Control Circuits: Type RHH, single conductor in raceway. UL classified with two hour fire rating when installed in EMT conduit per the NEC and UL electrical circuit protective system (FHIT) #25 of the UL fire resistance directory. Support every 5' on center.
- O. Variable Speed Drives to Motors: Use VFD power cable manufactured by Southwire or Draka. Support every 5' on center.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Basic Electrical Materials and Methods."
- F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."
- G. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).
- H. Identify and color-code conductors and cables according to Division 26 Section "Electrical Identification."
- I. All wiring shall be installed in conduit or approved raceway. All raceways shall be provided with a ground conductor unless noted otherwise on the Contract Documents.
- J. Use conductor not smaller than 12 AWG for power and lighting circuits. Unless indicated otherwise, all circuits shall be 2#12, 1#12G, ¾"C. Do not share neutrals.
- K. Use conductor not smaller than 14 AWG for control circuits, provided by Electrical Contractor.
- L. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- M. Use suitable cable fittings and connectors.
- N. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- O. Clean conductor surfaces before installing lugs and connectors.
- P. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- Q. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
- R. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- S. Branch circuits may be combined up to 6 circuits in a homerun conduit. Electrical Contractor shall be responsible for derating of conductors as required by N.E.C. Do not share neutrals.
- T. Use piercing connector with insulating covers for conductor splices and taps, 8 AWG and larger.
- U. Where the armor of type AC cable terminates, a fitting shall be provided to protect the wiring from abrasion. An approved bushing shall be provided between the conductors and the armor.

- V. Type MC cable shall be supported and secured at intervals not exceeding 4'-0".
- W. Fittings used for MC cable shall be identified for such use.
- X. AC/MC cable shall not be used for home runs to receptacle or distribution panels.
- Y. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

3.3 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 and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Description: Test all feeders rated 100 A and above.
 - 2. Visual and Mechanical Inspection
 - a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
 - b. Test cable mechanical connections with an infrared survey.
 - c. Check cable color-coding against project Specifications and N.E.C. requirements.
 - 3. Electrical Tests
 - a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
 - b. Perform continuity test to insure proper cable connection.
 - 4. Test Values
 - a. Minimum insulation resistance values shall be not less than fifty mega-ohms.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

****END OF SECTION****

GROUNDING AND BONDING

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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 grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements".
 - 2. Division 26 Section "Conductors and Cables".

1.3 REFERENCES

- A. ASTM B 3: Specification for Soft or Annealed Copper Wire.
- B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
- E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

- F. IEEE 142: Grounding of Industrial and Commercial Power Systems.
- G. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
- H. IEEE C2: National Electrical Safety Code.
- I. NETA MTS – 2001: Maintenance Testing Specifications.
- J. NFPA 70: National Electrical Code.
- K. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
- L. NFPA 780: Lightning Protection Code.
- M. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
- N. UL 96: Lightning Protection Components.
- O. UL 467: Grounding and Bonding Equipment.
- P. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- Q. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Data: For the following:
 - 1. Ground rods.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - 4. Indicate overall system resistance to ground.
 - 5. Indicate overall Telecommunications system resistance to ground.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 26 "Electrical General Requirements".
- B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer to specification section "Electrical Testing."

- B. 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.
 - 1. Comply with UL 467.
- C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- E. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".
- F. Comply with ANSI/IEEE 1100 -1992 "Powering and Grounding Sensitive Electronic Equipment".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors and Cables:
 - a. Refer to Division 26 Section "Conductors and Cables".
 - 2. Grounding Rods:
 - a. American Electric-Blackburn.
 - b. Apache Grounding/Erico Inc.
 - c. Chance/Hubbell.
 - 3. Mechanical Connectors:
 - a. American Electric-Blackburn.
 - b. Burndy.
 - c. Chance/Hubbell.
 - 4. Exothermic Connections:
 - a. Cadweld.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
- B. Material: Aluminum, copper-clad aluminum, and copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.

- F. Underground Conductors: Bare, tinned, stranded, copper unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- H. Copper Bonding Conductors: As follows:
 - 1. Bonding Conductor: Stranded copper conductor; size per the NEC.
 - 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
 - 3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.
- I. Aluminum Bonding Conductors: As follows:
 - 1. Bonding Conductor: Stranded aluminum conductor; size per the NEC.
 - 2. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; size per the NEC.
- J. Ground Conductor and Conductor Protector for Wood Poles: As follows:
 - 1. No. 4 AWG minimum, soft-drawn copper conductor.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
- K. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.
- L. Telecommunications Main Grounding Busbar (TMGB)
 - 1. 48" (min) x 4" x 1/4" tin plated, copper busbar with three rows of 1/4 x 20 tapped holes 3" on center.
- M. Telecommunications Grounding Busbar (TGB)
 - 1. 12" (min) x 2" x 1/4" tin plated, copper busbar with two rows of 1/4 x 20 tapped holes 3" on center.
- N. Telecommunications Bonding Backbone (TBB)
 - 1. Minimum No. 2 AWG insulated stranded copper.
- O. Telecommunications Bonding Conductors
 - 1. Minimum No. 6 AWG insulated stranded copper.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.
- D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
 - 1. Size: 5/8 (16 mm) in diameter.
 - 2. Length: 120 inches (3000 mm).
- B. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Provide handholes as specified in Division 2 Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.
- D. In raceways, use insulated equipment grounding conductors.
- E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- F. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- G. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- H. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at the isolated equipment ground bus of the source panelboard unless otherwise indicated.
- I. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard

grounding terminals. Terminate at the isolated ground bus in the circuit's overcurrent device enclosure unless otherwise indicated.

- J. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- K. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- L. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- M. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- N. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.2 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to 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.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations.
- D. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
- E. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- F. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

- G. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- H. Tighten screws and bolts for grounding and bonding 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.
- I. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- J. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.3 INSTALLATION

- A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:
 - 1. Ground rods.
 - 2. Counterpoise ground.
 - 3. Ufer ground.
 - 4. Lightning protection system.
 - 5. Metal water service pipe.
 - 6. Plate electrode.
- B. Ground Rods: 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.
 - 1. Verify that final backfill and compaction has been complete before driving ground rods.
 - 2. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- C. Counterpoise Ground:
 - 1. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
 - 2. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use conductors not less than No. 2/0 AWG for counterpoise and for tap to building steel. Bury counterpoise not

less than 18 inches (450 mm) below grade and 24 inches (600 mm) from building foundation.

- D. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c):
1. Provide a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.
 3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.
- E. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor. Install in conduit where routed above grade.
- F. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.
- G. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- H. Metal Water Service Pipe: Provide 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 by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- I. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- J. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- K. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- L. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers to grounding electrodes per NFPA 70.
- M. Packaged Engine Generator: Solidly ground the packaged engine generator neutral to the normal power source neutral. Do not ground the generator neutral to a separate grounding electrode.
- N. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- O. Grounding Bus:

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1. Install grounding bus in the locations listed below and elsewhere as indicated:
 - a. Electrical equipment rooms.
 - b. Telephone equipment rooms.
 - c. Rooms housing service equipment.
 2. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
- P. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.
- Q. Access Floor Pedestal Ground: Ground access floor pedestals where indicated.
1. Provide access floor pedestal ground plate where indicated.
 - a. Provide ½ inch (12 mm) thick x 4 inches (102 mm) wide x 12 inches (305 mm) long, soft copper bar, bolted construction with minimum six 3/8 inch (10 mm) diameter drilled holes 1 ½ inches (38 mm) on center.
 - b. Provide cadmium plated bolts, nuts and screws.
 - c. Mount plate on ¾ inch (19 mm) plywood with 2 inch (50 mm) wood spacers.
 2. Provide No. 2 AWG insulated ground conductor from pedestal to pedestal ground plate or building steel.
 3. Provide No. 2 AWG insulated ground conductor from pedestal ground plate to building steel.
 4. Tie wrap ground conductor as close to concrete floor as possible at every other pedestal.
 5. Clean all pedestals prior to welding.
- R. Access Floor Ground Grid: Install ground grid under access floors where indicated.
1. Construct grid of No. 2 AWG bare copper wire installed on 24 inch centers both ways.
 2. Bond each access floor pedestal to grid.
- S. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Bond to pedestal ground plate or Bond to building steel. Use No. 2 AWG bare copper conductor.
- T. Provide grounding and bonding in patient care areas to meet requirements of NFPA 99 and ANSI/NFPA 70.
- U. Bond together metal siding not attached to grounded structure; bond to ground.
- V. Pool Structures: Provide a common bonding grid with a solid copper conductor not smaller than No. 8 AWG. Bond together the following:
1. All metallic parts of the pool or fountain structure, including reinforcing steel of the pool or fountain shell, coping stones, and deck.
 2. All forming shells and mounting brackets of no-niche luminaries.

3. All metal fittings within or attached to the pool or fountain structure that are greater than 4 inches (100 mm) in any dimension and penetrate the pool or fountain structure more than one inch (25 mm).
 4. Metal parts of electrical equipment associated with the pool or fountain water circulating system, including pump motors and metal parts of equipment associated with pool covers, including electric motors.
 5. Metal sheathed cables and raceways, metal piping, and all fixed metal parts including fences, awnings, door and window frames, except those separated from the pool or fountain by a permanent barrier shall be bonded that are within the following distances of the pool:
 - a. Within 5 feet (1.5 m) horizontally of the inside walls of the pool.
 - b. Within 12 feet (3.7 m) measured vertically above the maximum water level of the pool, or any observation stands, towers, or platforms, or any diving structure.
- W. Provide a flexible braid bonding jumper at each set of columns at expansion joints.

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven ground rod close to wall, inside manhole, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. Connections to Manhole Components: Connect all exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformers/substations by connecting them to underground cable and grounding electrodes. Use not less than a No. 2 AWG conductor for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches (450 mm) below grade and 6 inches (150 mm) from the foundation.

3.5 TELECOMMUNICATIONS GROUNDING

- A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:
 1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main building electrical grounding electrode system via a No. 3/0 AWG copper ground conductor.
 2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.
 3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.
 4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB's or TMGB using

approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

- B. All bonding connections shall be installed at an accessible location for inspection and maintenance.
- C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.
- D. The physical routing shall, in general, follow the same path as the backbone cable system.
- E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.
- F. Do not use TGB's as a power system ground connection unless specifically noted on the Drawings.
- G. All bonding connectors and conductors shall be UL listed for the purpose intended.
- H. Mount TMGB and TGB bus to backboard or wall using 2" standoff insulators.
- I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.
- J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB's to TBB with bare No. 6 AWG copper ground conductor and T-tap grounding hardware.

3.6 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
 - 2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
 - b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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.
 - c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.
 - d. Perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81).
 - e. Equipment Grounds: Utilize two-point method of IEEE 81. Measure between equipment ground being testing and known low-impedance grounding electrode or system.
 - 3. Provide drawings locating each 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.

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- a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.
 - f. The telecommunications grounding system shall have a maximum resistance of 1 ohm as measured from the TMGB ground to earth ground.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

****END OF SECTION****

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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. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

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- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
 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:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 4. Fitting and Accessory Materials: Same as channels and angles.
 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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 malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

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- G. 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. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 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 Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. 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 single-bolt conduit clamps using spring friction action for retention in support channel.
- D. 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.
- E. Support all electrical items independently of supports provided by the other trades.
- F. Support conduits and boxes using steel conduit straps or 1/4-inch minimum diameter threaded rod hangers. Suspended ceiling hangers or hanger wire shall not be used (except to support flexible metallic conduit and manufactured wiring systems).
- G. Support cable trays with support brackets or 3/8" diameter minimum threaded rod hangers at intervals not exceeding 8'-0" for straight runs. Additional supports shall be provided at tray fittings.
- H. Hangers shall be of sufficient strength that their deflection at mid span does not exceed 1/240 of the hanger span length after the cables are installed.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- 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).
- C. 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 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 by means that meet seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
 - E. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
 - F. Obtain permission from Architect/Engineer before using powder-actuated anchors.
 - G. Obtain permission from Architect/Engineer before drilling or cutting structural members.
 - H. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
 - I. Install surface-mounted cabinets and panelboards with minimum of four anchors.
 - J. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.
 - K. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
 - L. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 5 Section "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. Provide concrete bases for all floor mounted electrical equipment.

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- B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.
- C. Base/Pad Construction:
 - 1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.
 - 2. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.
- D. Anchor equipment to base per both supports and equipment manufacturer's instructions.
- E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

****END OF SECTION****

RACEWAYS AND BOXES

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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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - B. Related Sections include the following:
 1. Division 26 Section, "Basic Electrical Materials and Methods" for exterior ductbanks, manholes, and underground utility construction.
 2. Division 7 Section, "Through-Penetration Firestop Systems"
 3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
- 1.3 DEFINITIONS
 - A. EMT: Electrical metallic tubing.
 - B. ENT: Electrical nonmetallic tubing.
 - C. FMC: Flexible metal conduit.
 - D. IMC: Intermediate metal conduit.

- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.
- H. PVC: Polyvinyl Chloride.
- I. HDPE: High Density Polyethylene.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Manufacturer Seismic Qualification Certification: Submit certification that enclosures, cabinets, accessories, and components will withstand seismic forces defined in Division [16][26] Section "Electrical Supports and Seismic Restraints." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity 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.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.
- C. All work in natatorium/pool area shall be in accordance with N.E.C. article 680, "Swimming Pools, Fountains, and Similar Installations."

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. Alfex Inc.
3. Allied Tube Triangle Century.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. International Metal Hose.
6. Electri-Flex Co
7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
9. Maverick.
10. O-Z Gedney; unit of General Signal.
11. Wheatland.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT and Fittings: ANSI C80.3.

1. Fittings: Steel set-screw type.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 FIRE ALARM EMT

A. Manufacturers:

1. Allied Tube Triangle Century.
- B. EMT conduit with bright red topcoat; Fire Alarm EMT.
- C. EMT and Fittings: ANSI C80.3.

2.4 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:

1. American International.

2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Condux International.
7. ElecSys, Inc.
8. Electri-Flex Co.
9. Integral.
10. Kor-Kap.
11. Lamson and Sessions: Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.
13. RACO; Division of Hubbell, Inc.
14. Scepter.
15. Spiralduct, Inc./AFC Cable Systems, Inc.
16. Thomas & Betts Corporation.

- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- E. LFNC: UL 1660.
- F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

2.5 METAL WIREWAYS

- A. Manufacturers:
 1. Hoffman.
 2. Square D.
- B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.
- C. Fittings and Accessories: Include 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. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

- E. Wireway Covers: Hinged type.
- F. Finish: Manufacturer's standard enamel finish.

2.6 NONMETALLIC WIREWAYS

- A. Manufacturers:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include 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.
- E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.7 SURFACE RACEWAYS

- A. Surface raceway (Wiremold – ivory color) shall be used in finished areas. Do not use EMT conduit in finished areas unless directed by the Architect.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating and ivory finish.
 - 1. Manufacturers:
 - a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.8 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2. Shall be used in corrosive areas.
- D. Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Floor Boxes: Nonmetallic, nonadjustable, round.

- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.9 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors Applications:
 - 1. Exposed: Rigid steel or IMC.
 - 2. Concealed: Rigid steel or IMC.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R.
- B. Indoor Applications:
 - 1. Exposed, Not Subject to Physical Damage in non-finished areas: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage in non-finished areas: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit up to 10'-0" above finished floor. Includes raceways in the following locations:
 - 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): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: IMC.
 7. Raceways Embedded in Concrete Above Grade: EMT or Rigid Steel.
 8. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 9. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 10. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 11. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. Rigid Steel Conduits: Use only fittings approved for use with that material.
 3. EMT Conduits: Use steel set-screw fittings.
- E. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION

- A. Install conduit in accordance with NECA "National Electrical Installation Standards".
 - B. 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.
 - C. Complete raceway installation before starting conductor installation.
 - D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
 - E. Install temporary closures to prevent foreign matter from entering raceways.
 - F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
 - G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
 - H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

- I. Raceways Embedded in Slabs:
 - 1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
 - 2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
 - 3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 4. Space raceways laterally to prevent voids in concrete.
 - 5. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 6. Conduits shall run flat. Do not allow conduits to cross.
- J. Raceways installed under slab on grade: Use Schedule 40 nonmetallic conduit with rigid steel conduit sweeps, route conduits a minimum of 6" below bottom of slab.
- K. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- L. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors.
- M. Tighten set screws of threadless fittings with suitable tools.
- N. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- O. 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.
- P. Provide pull string and 25% spare capacity in every branch circuit conduit.
- Q. Telephone and Signal System Raceways, 2-Inch Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

1. Electrical conduit (LB's) are not permitted.
 2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
 3. Conduits shall contain no continuous sections longer than 100 ft. without a pull point/box.
 4. The bend radius of conduit must be at least 6 times the internal diameter for a conduit 2 inches or less and a radius of 10 times the diameter for a conduit greater than two inches.
 5. All conduit ends shall have an insulated bushing.
- R. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- S. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- T. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- U. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- V. Set floor boxes level and flush with finished floor surface.
- W. Set floor boxes level. Trim after installation to fit flush with finished floor surface.
- X. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- Y. Do not route feeders across roof.
- Z. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.
- AA. Conduit run in natatorium/pool area shall be EMT with compression fittings, and painted by the painting contractor (corrosion treatment paint per Architect's requirements).
- BB. Provide bonding of the pool structure/equipment per N.E.C. article 680-22. Coordinate with the pool contractor.
- CC. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

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- DD. Conduits that route through, to, or from a hazardous classified space (Class I or II) shall have proper seal offs when exiting or entering the hazardous classified space.
- EE. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.
- FF. Offset outlet boxes on opposite sides of common walls to prevent sound transmission between adjoining rooms.
- GG. Firestop raceways passing through rated walls and floors in accordance with Division 07 specifications. See architectural drawings for locations of rated assemblies.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

****END OF SECTION****

ELECTRICAL IDENTIFICATION

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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. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.
- E. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.
- B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb, minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.8 WIRING DEVICE IDENTIFICATION

- A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Raceways and Duct Banks More Than 600 V Concealed within Buildings: 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with self-adhesive vinyl labels. Repeat legend at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 400 A: Identify with orange self-adhesive vinyl label.
- D. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
1. Fire Alarm System: Red.
 2. Fire-Suppression Supervisory and Control System: Red and yellow.
 3. Combined Fire Alarm and Security System: Red and blue.
 4. Security System: Blue and yellow.
 5. Mechanical and Electrical Supervisory System: Green and blue.
 6. Telecommunication System: Green and yellow.
 7. Control Wiring: Green and red.
- E. Power-Circuit Conductor Identification: For primary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- F. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.
- G. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- H. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

- J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- L. Provide a 3" by 5" yellow "Warning Arc Flash Hazard" label on the outside of panels in 'occupant areas' - Brady Type 99454 or equivalent from another manufacturer. Center the label horizontally and vertically on outside of door.
- M. Provide a 4" by 6" red "Danger Arc Flash and Shock Hazard" label on the outside of panels in areas open only to 'qualified personnel', and on the inside panel door of panels in 'occupant areas' - Brady Type 99459. Center label on gutter areas of distribution panels, centered above or below the directory of panels, and otherwise centered in other applications. In all cases, label will be no lower than 48" or above 84" AFF
- N. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 - 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer or load shedding.
- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Mechanically secured, Engraved, laminated acrylic or melamine label. 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 label; where 2 lines of text are required, use labels 2 inches (50 mm) high. Labels shall be 2 1/2" high x 4 1/2" wide. Provide 3 lines of text. Line one shall have 1/2" letters spaced 1/2" down from top of label. Lines 2 and 3 shall have 1/4" letters. Each line shall be spaced 1/4" apart.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Transformers.
 - e. Emergency system boxes and enclosures.
 - f. Motor-control centers.
 - g. Disconnect switches.
 - h. Enclosed circuit breakers.
 - i. Motor starters.
 - j. Push-button stations.
 - k. Power transfer equipment.
 - l. Contactors.
 - m. Remote-controlled switches, dimmer modules, and control devices.
 - n. Intercommunication and call system master and staff stations.
 - o. Fire-alarm control panel and annunciators.
 - p. Breakers at distribution panels.
- P. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location:
 - 1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
 - 2. Conduit Markers: Provide identification for each power conduit two inches or larger.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- E. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.

- b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 - e. Ground: Green.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- I. Label information arrangement for 3 lines of text.
 1. Line one shall describe the panel or equipment. Line one example: "DP-XX," RP-XX," "T-XX," "EF-XX," etc.
 2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
 3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
 4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.
- J. Examples:

RP-1A FED FROM PP-2 ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM PP-1 MECHANICAL ROOM F101	LP-1A FED from MDP ELECTRICAL ROOM A100
--	---	---
- K. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- L. Degrease and clean surface to receive nameplates.
- M. Install nameplate and labels parallel to equipment lines.
- N. Secure nameplate to equipment front using screws.
- O. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

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- P. Identify conduit using field painting where required.
- Q. Paint red colored band on each fire alarm conduit and junction box.
- R. Paint bands 10 feet on center, and 4 inches minimum in width.
- S. Labels shall be neatly centered. Place labels in like positions on similar equipment.

****END OF SECTION****

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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 lighting control devices:
 - 1. Occupancy sensors.
 - 2. Lighting contactors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements".
 - 2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 REFERENCES

- A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
- C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.
- D. NFPA 70: National Electrical Code.
- E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- F. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.
- H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.
- I. UL 917: Clock Operated Switches.
- J. UL 1449: Transient Voltage Surge Suppressors.
- K. UL 1598: Luminaires.
- L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.4 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.
- C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.
- D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.
- E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated including physical data and electrical performance.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.

2. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
 1. Description of operation and servicing procedures.
 2. List of major components.
 3. Recommended spare parts.
 4. Programming instructions and system operation procedures.

1.6 QUALITY ASSURANCE

- A. 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.

1.7 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under provisions of Division 26 Section "Electrical General Requirements".
- B. Store and protect products under provisions of Division 26 Section "Electrical General Requirements".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 OCCUPANCY SENSORS

A. General

1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer's recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.
4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.

B. Wall Switch Passive Infrared Occupancy Sensor

- C. 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:

- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Leviton ODS15-IDW
2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
 - a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
 - b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
 - c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - d. Device Body: White, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with "decora" style switch plate.
3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.

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- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Leviton ODS0D-IDW

E. 360° Ceiling Mounted Dual Technology Occupancy Sensor

- 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:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton OSC20-M0W
- 3. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant ceiling mount.
 - b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 15 seconds to 30 minutes.
 - d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - e. Manual override function.

F. 110° Wall Mounted Dual Technology Occupancy Sensor

- 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:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton OSW12-M0W
- 3. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
 - b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 15 seconds to 15 minutes.
 - d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
 - e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.

- f. Manual override function.

G. 360° Ceiling Mounted Ultrasonic Occupancy Sensors

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton OSC20-U0W
3. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant.
 - b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 15 seconds to 15 minutes.
 - c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - d. Manual override function.

H. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton OSC15-I0W
3. Description: Ceiling mounted, 360° coverage, infrared sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant ceiling mount.
 - b. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - d. Manual override function.

I. Occupancy Sensor Control Units: OPP20-OD1

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
 - a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
 - b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.

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- c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
- d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
- e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
- f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.4 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Square D.

B. Contactor

- 1. Electrically-operated electrically-held unless otherwise indicated 600 volt, 30 ampere three pole with number of poles indicated.
- 2. Provide contacts to be 100 percent, continuously rated for all types of ballast and tungsten lighting and resistance loads without the need for in-rush current derating.
- 3. Provide NEMA type 1 enclosure unless otherwise indicated.
- 4. Provide NEMA type 1 hinged cover cabinet enclosure sized as required for contactors as indicated on drawings. Mount switches and indicating lights required on front of enclosure. Install terminal strips for connection of all external control wiring connections.
- 5. Provide solderless pressure wire terminals.
- 6. Provide corrosion-resistant primer treatment with light gray baked acrylic enamel finish.
- 7. Provide the following control and indicating devices:
 - a. Auxiliary contacts: One field convertible.
 - b. Auxiliary relay to convert maintained-contact type control circuit to momentary-contact type control circuit necessary for contactor control.
 - c. Green pilot light to indicate "power on" condition. Mount on front cover with legend plate.

PART 3 - EXECUTION

3.1 LIGHTING CONTACTOR INSTALLATION

- A. Install lighting contactors as indicated on plan. Install at accessible locations. Switch controls where provided shall be no higher than 54" or lower than 48".
- B. Demonstrate proper operation of all lighting control functions to the Owner and Engineer.

3.2 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

- A. Mount photocell on roof or parapet to ½" GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.
- B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.
- C. Adjust photocell sensitivity and delay to meet owner's requirements. Multiple adjustments may be required, as needed.

3.3 TIME CONTROLLER INSTALLATION

- A. Install time controller, near contactor control equipment or as indicated on plan. Install at accessible location.
- B. Program time controller as directed by the owner. Train owner in time clock programming.

3.4 OCCUPANCY SENSOR INSTALLATION

- A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.
- B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.
- C. Locate sensors such that motion through open doors will not falsely activate sensors.
- D. Do not locate ultrasonic sensors within six feet of supply air diffusers.
- E. Locate infrared sensors to avoid obstructions.
- F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.
- G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors. The owner shall dictate the setting of the time delay in all sensors.

3.5 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

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- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. 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 and UL 486B.

3.6 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

****END OF SECTION****

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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. Single and duplex receptacles, ground-fault circuit interrupters, integral surge suppression units, and isolated-ground receptacles.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Pin and sleeve connectors and receptacles.
5. Floor service fittings, poke-through assemblies, access floor boxes, and service poles.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.

- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 REFERENCES

- A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
- B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes
- D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
- E. NEMA WD 1: General Requirements for Wiring Devices.
- F. NEMA WD 6: Wiring Device – Dimensional Requirements.
- G. UL 20: General-Use Snap Switches.
- H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- I. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- J. UL 498: Electrical Attachment Plugs and Receptacles.
- K. UL 943: Ground Fault Circuit Interrupters.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.
- B. Qualification Data: For testing agency.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
- 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 NFPA 70.

1.7 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 RECEPTACLES

- A. All receptacles shall be tamper proof.
- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
- C. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498. Configuration 5-20R duplex receptacle.
 - 1. Manufacturers:
 - a. Leviton TBR20.
- D. GFCI Receptacles: Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.
 - 1. Manufacturers:
 - a. Leviton T7899-HGG.
- E. Industrial Heavy-Duty Pin and Sleeve Devices: Comply with IEC 309-1.
- F. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.

2.3 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated; Wiring Device-Kellems 1220 Series.
 - 2. Cooper Wiring Devices 2221 Series.
 - 3. Leviton 1220 Series.
 - 4. Bryant 4900 Series.
 - 5. Pass & Seymour/Legrand; Wiring Devices Division PS20AC Series.
- B. Device body: Plastic toggle handle.

- C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- D. Provide single-pole, two-pole, three-way and four-way switches as indicated.
- E. Provide pilot light where indicated.
- F. Provide key type where indicated. Furnish a minimum of six keys to Owner.
 - 1. Switch shall be Hubbell 1220 series (or equal as specified above) with locking coverplate.
 - 2. Coverplate shall be Hubbell HBL96062, straight keyed cylinder type lock, with stainless steel finish.
- G. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - 1. Switch: 20 A, 120/277-V ac.
 - 2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.4 DIGITAL TIME SWITCHES

- A. General:
 - 1. Watt Stopper TS-400 or equal. Operation on 100 to 300 volts.
 - 2. Digital time switch turns lights off automatically after pre-set time. Pushbutton operation with time setting from 5 minutes to 12 hours.
 - 3. Back-lit LCD shows timer countdown.

2.5 DIMMER SWITCHES

- A. General:
 - 1. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 - 2. Dimmer switches shall provide full-range, variable control of light intensity utilizing a continuous Square Law dimming curve.
 - 3. Provide protected memory during temporary power failures that restores lights to same level of intensity set prior to power interruption.
 - 4. Provide dimmer switches UL listed for the type of load being served (incandescent, fluorescent, magnetic low voltage transformer, electronic low voltage transformer). Universal load-type dimmer switches shall not be acceptable.
 - 5. Provide dimmers that provide no adverse effects on other components of the electrical system being served (low voltage transformers, ballasts, lamps, etc.).
- B. Incandescent Lamp Dimmers:
 - 1. Manufacturers:
 - a. Lutron Model N-2000-W.

- b. Leviton Model 82000-W.
 - c. Hubbell equal.
- 2. Modular, 120 V, 60 Hz with continuously adjustable control; single pole with soft tap or other quiet switch; and 5-inch wire connecting leads.
- 3. Dimmer switches serving magnetic low voltage transformers shall be designed to control and provide a symmetrical ac waveform to the input of the magnetic low voltage transformer and not cause the transformer to operate above its rated operating current or temperature.
- 4. Dimmer switches serving solid-state low-voltage transformers shall not affect the sound rating of the transformer and not cause lamp flicker at any point in the dimming range.
- 5. Control: Continuously adjustable slider with slide-to-off; with single-pole or three-way switching to suit connections.
- 6. Power Rating: 2000 W.
- C. Fluorescent Lamp Dimmer Switches:
 - 1. Manufacturers:
 - a. Hubbell Incorporated; Wiring Device-Kellems
 - b. Lutron.
 - c. Leviton.
 - 2. Modular; single-pole, compatible with electronic dimming ballast provided with fluorescent light fixtures and rated for the specified load and voltage; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
 - 3. Control: Continuously adjustable slider with pre-set; single-pole or three-way switching to suit connections.
 - 4. Power rating: 1200 W.

2.6 WALL PLATES

- A. Manufacturers:
 - 1. Provide wall plates and corresponding wiring devices from same manufacturer.
- B. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Wet Locations: Gasketed Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
 - a. Manufacturers:

- 1) Red Dot Model CKSGV (cast aluminum), Thomas & Betts.

2.7 FLOOR SERVICE FITTINGS

- A. Manufacturers:
 1. Wiremold.
- B. Type: Modular, fully adjustable recessed-type, with services indicated suitable for wiring method used.
- C. Compartments: Provide barrier separating power from telecommunications cabling. Provide recessed-type floor service fittings with independent compartments and feed through wiring capability.
- D. Service Plate: Provide service plate type as indicated. Provide protective ring for flush service plates.
- E. Power Receptacle(s): NEMA WD 6, Configuration 5-20R Heavy-duty grade duplex receptacle, black finish, unless otherwise indicated.
- F. Telecommunications Outlet: Blank cover with bushed cable opening.

2.8 FINISHES

- A. Color:
 1. Wiring Devices Connected to Normal Power System: White at each school, unless otherwise indicated or required by NFPA 70.
 2. Wiring Devices Connected to Emergency Power System: Red.
 3. Wall Switches: White, unless otherwise indicated.
 4. Dimmer Switches: White, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
- C. Install devices and assemblies level, plumb, and square with building lines.
- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging according to manufacturer's written instructions.
- E. Arrangement of Devices:
 1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
 2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.

3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
 4. Install horizontally mounted receptacles with grounding pole on the left.
 5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
 6. Install switches with OFF position down.
- F. Install cover plates on switch, receptacle, and blank outlets in finished areas.
 - G. Use oversized plates for outlets installed in masonry walls.
 - H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
 - I. Remove wall plates and protect devices and assemblies during painting.
 - J. Coordinate installation of access floor boxes with access floor system provided by Architectural trades.
 - K. Install properly oriented access floor boxes into cutouts in access floor tiles and secure to tiles per Manufacturer's instructions.
 - L. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
 - M. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Electrical Identification."
 1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.
- B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.
- C. 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 and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:

1. Inspect each wiring device for defects.
 2. Operate each wall switch with circuit energized and verify proper operation.
 3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
 4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

****END OF SECTION****

FUSES

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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. Cartridge fuses rated 600 V and less for use in switches, switchboards, and controllers.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:

- 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- 2. Let-through current curves for fuses with current-limiting characteristics.
- 3. Time-current curves, coordination charts and tables, and related data.
- 4. Fuse size for elevator feeders and elevator disconnect switches.

- B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

- 1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
- 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

- C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 1 Section " Operation and Maintenance Data," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. 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.
- C. Comply with:
 - 1. NEMA FU 1 – Low Voltage Cartridge Fuses.
 - 2. NFPA 70 – National Electrical Code.
 - 3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - 4. UL 198E – Class R Fuses.
 - 5. UL 512 – Fuseholders.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 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. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.

3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
 1. Service Entrance: Class L, time delay.
 2. Feeders: Class J, time delay.
 3. Motor Branch Circuits: Class RK5, time delay.
 4. Other Branch Circuits: Class J, time delay.

2.3 FLUORESCENT AND H.I.D. LIGHTING BALLAST FUSES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Bussman, Inc. – GLR fuses with HLR holder.
 2. Tracor, Inc.; Littelfuse, Inc. Subsidiary – LGR fuses with LHR-000 holder.
 3. Ferraz Shawmut, Inc. – SLR fuses.
- B. Provide each fluorescent and HID lighting ballast with individual protection on the line side.
- C. Provide fuse and holder mounted within or as part of the fixture.
- D. Provide fuse size and type recommended by the fixture manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuses.

3.3 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

****END OF SECTION****

INTERIOR LIGHTING

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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. Interior lighting fixtures with lamps and ballasts.
 2. Lighting fixtures mounted on exterior building surfaces.
 3. Emergency lighting units.
 4. Exit signs.
 5. Accessories, including lighting fixture retrofitting.
- B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
2. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
- B. CRI: Color rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
 1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.
- E. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Submit under provisions of Section 26 0010.
- B. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Submit as one package, bound together. Include data on features, accessories, finishes, and the following:
 1. Physical description of fixture, including dimensions and verification of indicated parameters.
 2. Emergency lighting unit battery and charger.
 3. Fluorescent and high-intensity-discharge ballasts.
 4. Air and Thermal Performance Data: For air-handling fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
 5. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 15 Section "Diffusers, Registers and Grilles."
 6. Lamps.
 7. Photometric performance data.
- C. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- D. Wiring Diagrams: Power, signal, and control wiring.

- E. Coordination Drawings: Reflected ceiling plan(s) 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 lighting-fixture suspension systems will be attached.
 - 3. Other items in finished ceiling, including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Access panels.
 - 4. Perimeter moldings.
 - F. Samples for Verification: For interior lighting fixtures designated for sample submission in the Interior Lighting Fixture Schedule.
 - 1. Lamps: Specified units installed.
 - 2. Ballast: 120-V models of specified ballast types.
 - 3. Accessories: Cords and plugs.
 - G. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.
 - H. Source quality-control test reports.
 - I. Field quality-control test reports.
 - J. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 - 1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.
 - K. Warranties: Special warranties specified in this Section.
- 1.5 QUALITY ASSURANCE
- A. 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.
 - B. Comply with:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.

3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
 4. Resource Conservation and Recovery Act (RCRA), May 1994.
 5. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).
 6. Code of Federal Regulations (47 CFR 37342).
 7. Michigan Department of State Police, Fire Marshall Division Policy Number 11-06 “Plastic Materials as Interior Finishes” pertaining to the use of plastic lenses in lighting fixtures for health care facilities.
 8. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.
- C. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Unit Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion at each project. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
- B. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion at each project.
- C. Manufacturer's Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
1. Warranty Period: One year from date of Substantial Completion at each project.

1.8 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. Lamps: 20 of each type and rating installed.
2. Plastic Diffusers and Lenses: 6 of each type and rating installed.
3. Fluorescent Emergency Battery Units: 3 of each type and rating installed.
4. Ballasts: 6 of each type and rating installed.

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. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 FIXTURES AND COMPONENTS, GENERAL

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1572. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. 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.
- H. 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.
 4. Laminated Silver Metallized Film: 90 percent.
- I. Plastic Diffusers, Covers, and Globes:
 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

- a. Lens Thickness: At least 0.125 inch minimum unless different thickness is scheduled.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
 - J. Electromagnetic-Interference Filters: A component of fixture assembly. Suppress conducted electromagnetic-interference as required by MIL-STD-461D. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.
 - K. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 15 Section "Diffusers, Registers, and Grilles."
 - 1. Air Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
 - 2. Heat Removal Units: Air path leads through lamp cavity.
 - 3. Combination Heat Removal and Air Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air supply units.
 - 4. Dampers: Operable from outside fixture for control of return-air volume.
 - 5. Static Fixtures: Air supply slots are blanked off, and fixture appearance matches active units.
 - L. General: Install ballasts, lamps, and specified accessories at factory. Replace and install any damaged lamps on project site.
- 2.3 LIGHTING FIXTURES
- A. As indicated on the drawings.
- 2.4 FLUORESCENT LAMP BALLASTS
- A. Description: Include the following features, unless otherwise indicated:
 - 1. Designed for type and quantity of lamps indicated at full light output except for emergency lamps powered by in-fixture battery-packs.
 - 2. Externally fused with slow-blow type rated between 2.65 and 3.0 times the line current.
 - B. Program rapid start electronic ballasts for linear lamps shall include the following features, unless otherwise indicated:
 - 1. Products:
 - a. Advance.
 - b. Universal Lighting.
 - 2. Comply with NEMA C82.11.
 - 3. Ballast Type: Programmed rapid start, unless otherwise indicated.

4. Programmed Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
 5. Sound Rating: A.
 6. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11. Input current third harmonic content shall not exceed 10%.
 7. Lamp end-of-life detection and shutdown circuit.
 8. Transient Voltage Protection: IEEE C62.41, Category A.
 9. Operating Frequency: 25 kHz or higher, and operate without visible flicker.
 10. Lamp Current Crest Factor: Less than 1.7.
 11. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
 12. Power factor shall be 90% minimum.
 13. Ballast factor shall be .875 to 1.00.
- C. Electromagnetic ballasts for linear lamps shall have the following features, unless otherwise indicated:
1. Products:
 - a. Advance.
 - b. Universal Lighting Technologies
 2. Comply with NEMA C82.1.
 3. Type: Energy-saving, high power factor, Class P, automatic-reset thermal protection.
 4. Ballast Manufacturer Certification: Indicated by label.
 5. Provide lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 6. Provide ballast suitable for lamps specified.
 7. Ballast shall not exceed sound level above Class A.
- D. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:
1. Products:
 - a. Advance: Mark 10.
 - b. Lutron.
 2. Dimming Range: 100 to 5 percent of rated lamp lumens.
 3. Ballast Input Watts: Can be reduced to 20 percent of normal.

4. Compatibility: Certified by manufacturer for use with specific dimming system indicated.
 5. Provide ballast suitable for specified lamp type.
- E. Ballasts for Low-Temperature Environments:
1. Temperatures 0 deg F and Higher: Electronic or electromagnetic type rated for 0 deg F minus 17 deg C starting temperature.
 2. Temperatures Minus 20 deg F (Minus 29 deg C) and Higher: Electromagnetic type designed for use with high-output lamps.
- F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.5 EXIT SIGNS

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: Incandescent, 2 for each fixture, 50,000 hours of rated lamp life.
 2. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
 3. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
 4. Additional Lamps for DC Operation: Two minimum, bayonet-base type, for connection to external dc source.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- D. Provide edge lit signs with a mirror plaque background.

2.6 EMERGENCY LIGHTING UNITS

- A. General: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads or fixtures.
5. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.

2.7 FLUORESCENT EMERGENCY BATTERY UNITS

- A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.
1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Night Light Connection: Emergency Light Fixtures shall NOT be connected as Night Lights.
 3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space. Install remote test switch and plate in adjacent ceiling tile.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
 5. Charger: Fully automatic, solid-state, constant-current type.
 6. Lamp Ratings:

<u>Lamp Type</u>	<u>Minimum Lumen Output (two lamps)</u>
F28T8	1400
F54T5HO	1400
 7. Universal transformer to operate at 120 volt or 277 volt.
 8. Products, linear fluorescent:
 - a. Lithonia PS1400 (with quick disconnect).
 - b. Equal by Bodine, Dual Lite or Iota (with quick disconnect that matches the Lithonia PS1400). Do not bid if quick disconnect is not identical to the Lithonia PS1400.

2.8 EMERGENCY LOAD TRANSFER DEVICE

- A. Manufacturers:
1. Nine-24, Inc.: BLTC Series.

2. Bodine GTD Series.
 3. Dual Lite.
 4. LVS.
 5. Side-Lite.
- B. Description: Localized load transfer switch to sense normal presence of normal power for switched circuits and switch luminaire over to emergency source upon loss of normal source. Device shall be installed integral to luminaire or mounted remotely as application required.
- C. U.L. 924 Listed.
- D. Integral test switch and indicating lamps to indicate status.

2.9 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.
- B. T5HO rapid start low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches 1148 mm, 4600 initial lumens (minimum), CRI greater than 80, color temperature 4100 K, and average rated life of 30,000 hours, unless otherwise indicated.
- C. **T8 rapid-start low-mercury lamps, rated 28 W maximum, 2650 initial lumens (minimum), CRI of 80 (minimum), color temperature of 4100 K, and average rated life of 80,000 hours at 3 hours operation per start, unless otherwise indicated.**
- D. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches 610 mm, 1300 initial lumens (minimum), CRI of 80 (minimum), color temperature of 4100 K, and average rated life of 60,000 hours at 3 hours operation per start, unless otherwise indicated
- E. Fluorescent Lamp Manufacturers:
1. Osram Sylvania.
 2. General Electric.
 3. Philips.

2.10 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Electrical Supports" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage.
- E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

- F. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.11 FINISHES

- A. Fixtures: Manufacturers' standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.

2.12 FLUORESCENT FIXTURE RETROFIT MATERIALS

- A. Comply with UL 1598 listing requirements.
 - 1. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed lighting fixtures by improving reflectivity of fixture surfaces. No electrical parts are to be changed.
 - 2. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets as scheduled.

2.13 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.
- B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- C. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- D. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.
 - 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

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- E. Support luminaires independent of ceiling framing. Support recessed grid luminaires from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- F. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
- G. Install recessed luminaires to permit removal from below.
- H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Fixture Support: As follows:
 - 1. Install suspended luminaires and exit signs using pendants supported from swivel hangers except where noted to use chain hangers. Provide pendant length required to suspend luminaire at indicated height.
 - 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 3. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 4. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 5. Continuous Rows: Suspend from cable.
- J. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.
- K. Adjust aimable fixtures to provide required light intensities.
- L. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- M. Where fluorescent fixtures are shown with dual switches, connect all inner lamps to one switch and all outer lamps to the other switch. Dim the inner lamps where a dimmer switch is shown.
- N. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.
- O. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.
- P. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Non-functioning lamps shall be replaced.
- Q. Mount fluorescent emergency lighting battery packs in accordance with the manufacturer's instructions. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.
- R. Mount sealed beam emergency lighting units where shown and aim their lamps to light the egress path as uniformly as possible.

3.2 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 and UL 486B.
- B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- C. Bond products and metal accessories to branch circuit equipment grounding conductor.
- D. Connect luminaires to branch circuit outlet boxes provided under Section 16130 using 1/2" flexible conduit.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Examine each luminaire to determine suitability for lamps specified.
- C. Verify normal operation of each fixture after installation.
- D. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- F. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.
- G. Check for variance in lamp color temperature throughout project.
- H. Spot check for lamp output level from start up through 10 minute duration and make rotation.
- I. All fluorescent and H.I.D. lamps shall be allowed to run a minimum of 100 hours, continuously, prior to punchlist or any dimming.
- J. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.4 ADJUSTING

- A. Aim and adjust luminaires as directed by the Architect/Engineer.
- B. Adjust exit sign directional arrows as indicated on Drawings.
- C. Relamp luminaires that have failed lamps at Substantial Completion.
- D. Adjust all "low end trim" settings of dimming switches prior to punchlist.
- E. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.

3.5 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures and lenses.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

****END OF SECTION****

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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. General Scope	
1. Expand the existing public address system, including new speakers and cable. Tone and test existing cable. Replace defective cable as required for a complete operating system.	
2. Provide complete and fully functional systems with devices and components as required and as indicated. System as shown and as specified represents design intent and is not reflective of installed quantities and miscellaneous components, except as minimums.	
1.3 SUBMITTALS	
A. Product Data: For the following:	
1. Wall and ceiling mounted speaker assemblies.	

2. Outdoor speakers.
 3. Public address/intercom system.
 4. Controls, amplifiers, and terminal equipment.
 5. Power supplies.
 6. Wiring.
- B. Shop Drawings:
1. Equipment Details: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.
 2. Station-Arrangement Details: Scaled drawings for built-in equipment.
 3. Wiring Diagrams: Power, signal, and control wiring. Include the following:
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For school intercom and program equipment to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Sections, include the following:
1. Record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
- B. 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.
- C. Comply with NFPA 70.
- D. Comply with UL 50.
- E. The contractor shall be an established communications contractor that has had and currently maintains a locally run and operated business for at least five (5) years. The contractor shall utilize a duly authorized distributor of the equipment supplied for this project location with full Rauland's five (5) year warranty.

- F. The contractor shall show satisfactory evidence, upon request, that the supplier maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system.

1.5 COORDINATION

- A. Coordinate layout and installation of system components, such as ceiling mounted speaker microphones 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from the manufacturers specified.

2.2 SUPPLIER AND SYSTEM INTEGRATOR:

- A. Provide products through the following:
 - 1. Sound Engineering (contact Barry Gilbert at 734-522-2910): shall provide service for the Dukane P.A. equipment.
- B. Expand the existing Public Address consoles as required. Provide new speakers as indicated on drawings. Provide all new components that are required in each existing P.A. console for a complete, fully functional system.

2.3 PUBLIC ADDRESS SYSTEM CONSOLE/EQUIPMENT

- A. The existing Public Address console is a Dukane Model MCS350. The system shall consist of a central equipment cabinet, Telapex digital card, analog card, telephone interface card (coordinate requirements with the Technology Contractor), one or more switching cards as required by number of remote stations in the system (plus 25% spare capacity), power supply, one or more power amplifiers as required, four Administration Control Consoles (ACC), remote station loudspeaker assemblies, mounting rack/cabinet and all associated material, hardware, and wiring as required for a complete system.
 - 1. The system shall provide, as a minimum, the following features and functions:
 - a. Allow administrative intercom system functions to be accessed through DTMF telephone instruments.
 - b. Microprocessor-based equipment of modular design, using plug-in connections between all modules. Field cabling shall be terminated in a labeled punch block arrangement to simplify servicing.
 - c. Allow DTMF-type telephones to call individual classroom speakers, zone page, all call page, emergency page, and activate other alarm and time tones.
 - d. Three simultaneous communication paths:
 - 1) Direct dialing, two-way communications between locations equipped with an ACC or DTMF telephone and any room station equipped with a speaker or telephone handset.
 - 2) A second intercom channel between ACCs when multiple ACCs are used in the system.

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- 3) Simultaneous program distribution directed from any ACC without interrupting intercom channels.
2. One Central Control Unit (CCU) containing all the electronics required to handle all the functions of up to 64 remote stations in a wall cabinet model and 240 remote stations in a floor rack model.
3. The capability to originate emergency calls that take precedence over all routine calls. Emergency calls may be programmed from any call-in switch, or a normal call may be converted to emergency by holding the call-in switch in the CALL position for 1.5 seconds.
4. A single queue mode capability that places all incoming calls into a single common queue and allows directing all incoming calls to the ACC and DTMF telephones during limited staff operation.
5. System check with self-diagnosis and a watchdog timer.
6. System support for up to four ACCs, each having identical functions and control features, and each of which can be programmed for specific secretarial or administrative operations.
7. Automatic gain control on intercom speech to maintain constant speech level.
8. Built-in battery backup for internal system clock to maintain correct time while system is unpowered. All other programmed data is stored in nonvolatile EEPROM memory and is retained indefinitely.
9. Automatic preannounce tone over any loudspeaker selected for two-way communications. A privacy tone will sound whenever a loudspeaker is being monitored, with capabilities to stop the tone from the ACC as desired.
10. Distribution of paging announcements from any ACC or DTMF telephone to speaker and ACC locations on an all call, zone, and multiple zone basis, to any of the eight paging zones.
11. User-programmability of room stations and loudspeakers to any of eight available paging zones, class change zones, or no zones at all.
12. Unique system tones for emergency and civil emergency pages with distribution of emergency announcements from an ACC or DTMF telephone to all locations equipped with ACCs or loudspeakers. Emergency announcements will automatically override all other programs.
13. Custodial call tone to all speakers.
14. Audio program distribution (microphone, tape, tuner, or auxiliary) capability to selected remote stations, specified zones, or all remote stations equipped with audio loudspeakers.
15. Provisions for intercom communications in facilities having unshielded, twisted-pair cable from each speaker location.
16. Provision for optional line supervision of an open circuit condition.

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17. Shall synchronize system clock to an external master clock (Not Applicable).
18. Provision for handset use at remote stations.
19. Provisions to override remote sound systems during all call or emergency paging.
20. Provision for distribution of door open alarm to all or selected zones by closure of single switch contact.
21. Provide transfer of current call to another ACC.
22. Call holding capability.
23. Forwarding of calls assigned to a particular ACC to another ACC for call coverage.
24. Last number redial.
25. Speed dial access to specific remote stations.
26. Defeat of call-in tones at any ACC.
27. Ability to clear all calls registered on the ACC queue.
28. Scroll display of waiting calls and select calls to be answered in any order.
29. Ability to display ACC's number using ACC keypad.
30. Call waiting indication: Steady display for normal calls, flashing display for emergency calls in order of priority.
31. Call-in reminder in which unanswered calls repeat until answered.
32. Provide LCD of current call/calls waiting. Current time is displayed when the ACC is in an idle state. The alphanumeric readout of incoming calls will be sorted by room number and queue position. The number of calls waiting will also be displayed in order of priority.
33. Sequential review of all incoming calls/calls waiting at each ACC with 100 percent call retention.
34. One VOX handset (for private communications), built-in microphone, speaker and PUSH TO TALK button on each ACC for intercom communications.
35. Ability for external input points to be annunciated at the ACC.
36. Selective monitoring of audio program sources by the ACC before or during distribution.
37. Initiation of manual time tones by any ACC or DTMF telephone.
38. Access code restriction of ACC system programming to protect the system configuration.
39. Ability for any ACC to direct a program to any one, group of, or all remote stations.

40. Built-in diagnostic software for each ACC.
41. Easy, menu-driven programming.
42. ACC-keypad programmable system functions, including:
 - a. Architectural alphanumeric room numbers.
 - b. Five call-in priority levels.
 - c. 12-hour or 24-hour clock display when ACC is in idle state.
 - d. 256 events, eight time schedules, eight zones and eight user-programmable tones.
43. Factory-programmable function keys for specific system operations.
44. Ability for each remote station to be programmed to annunciate at any one or all ACC's.
45. Automatic distribution of user-programmable time signals activated by a built-in master time clock. Two hundred fifty-six programmable events are available which can be programmed to eight zones and eight schedules from an ACC.
46. Programming room stations, zones, or multiple zones to receive the program source on a selected room basis from the ACC, with the ability to view rooms receiving program material on the ACC display.
47. Allow external DTMF telephones to automatically select and access room stations for communications (for future provisions).
48. Input ports for monitoring external signals to activate TC2100 functions such as off-hour door alert, emergency tones and night transfer.
49. Output ports for activation of external equipment in response to ICS functions such as clock synchronization, all call override, and telephone or CO port off-hook to the ICS.
50. An RS-232 port for interface to a PC for remote diagnostics, remote programming, system information, saving and reloading of system programming, and hard copy output of all system.
51. An RS-485 port for long distance serial communication.
52. A built-in analog tone generator providing seven tones including chime.
53. The public address system console unit shall be able to support dialing or non-dialing future telephone handsets.
54. Public Address System Console shall signal class change tones via the speaker system. Time schedules shall be programmed per the Owner's direction. Time correction shall be via internal master clock.

B. Execution:

1. Install all equipment per manufacturer's specifications. Prior to any programming, the contractor shall meet with the Owner for final approval of all system operations. Provide

four (4) hours of in service to the Owner on both operation of the system and programming. The contractor shall provide the program software as required for the system.

2.4 FUNCTIONAL DESCRIPTION OF INTERCOM SYSTEM

- A. The system shall be capable of multiple open voice intercom paths used for intercom, paging, program distribution, or emergency paging. The system shall be initially equipped with one intercom speech path.
- B. Provide a separate circuit for each classroom and administrative office so each room can be individually addressed with bi-directional communications.
- C. All field wiring shall be individually supervised for opens or shorts to each call station and security device.
- D. Arming and disarming functions shall be performed by dial-up via the Administrative Telephone(s).
- E. The audio channel(s) shall be priority driven allowing for the highest priority signal type access to a voice channel. The system shall be user programmable to allocate, upon demand, the audio channel(s) to facilitate simultaneous intercom conversations, pages, program distributions, or combination thereof.
 - 1. Facilities for up to 6 call-in priority levels.
 - 2. Every point shall support a programmable priority level.
 - 3. Distribution of paging announcements can be made from any administrative control console, telephone, or dedicated microphone set-up.
 - 4. Emergency announcements shall have the highest priority over any other system function.
 - 5. System shall support general announcements made from a conventional microphone to facilitate reading a script and the participation of multiple announcers.
 - 6. Keying the microphone shall automatically mute all other audio programs at a lower priority in the system and transmit the microphone audio to All Rooms or specific speaker zones, as programmed into the system software.
 - 7. Corridor speakers and outside horns shall be combined into groups of owner's preference.
 - 8. Facilities to provide automatic emergency instructions to be broadcast to the entire school when an alarm is tripped. The emergency instructions are preprogrammed and require no user intervention.
 - 9. Facilities to page one or more area-wide pocket pagers when a call is placed for a specific call priority or call priorities. The pocket pager will display the calling room number and a numeric call priority.

2.5 EQUIPMENT AND MATERIALS

- A. Coordinate features to form an integrated system. Coordinate components with existing systems where required. Match system voltages. Match components and interconnections for optimum performance of specified functions.

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- B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- C. Equipment: Modular type using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- D. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations.

2.6 MASTER CONTROL STATION

- A. Micro-processor based desktop console with LCD display.
- B. The console shall be equipped with 12-digit keypad and telephone handset to allow private conversations.
- C. Provide built-in microphone and speaker shall provide for push-to-talk intercom conversations.
- D. Incoming calls shall be enunciated on a 16-character LCD backlit digital display sorted by priority and order received.
- E. The console shall also provide the ability for the operator to place on hold, or clear any incoming calls registered in the system from the console keypad.
- F. The console shall retain the last room number dialed until another room number is dialed or previous call is cancelled.

2.7 PAGING AMPLIFIERS

- A. Minimum Output Power: Provide sufficient power to all corridor/classroom speakers to be tapped at 1 watt each; all outdoor speakers to be tapped at 5 watts each. Provide a minimum of 30% "headroom" amplifier power to full load status.
- B. Total Harmonic Distortion: Less than 1 percent at rated output power with load equivalent to total quantity of stations connected in all call mode.
- C. They shall be designed to operate on a line voltage of 115 AC. One amplifier shall be provided for each audio channel.
- D. Minimum Signal to Noise Ratio: 60 dB, at rated output.
- E. Frequency Response: Within plus or minus 2dB from 50 to 12,000 Hz.
- F. Amplifier Protection: Prevent damage from shorted or open circuit.

2.8 P.A. CALL STATION

- A. Dukane model as required, Call Switch, single gang flush mounted with stainless steel faceplate. Single normal call button. Provide wiring as required by the manufacturer.

2.9 CEILING AND WALL MOUNTED SPEAKERS

- A. Classroom Speakers - PA speakers shall have the following coverall characteristics:
 - 1. Diameter: 8".

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2. Frequency Response: 60-16000 Hz.
 3. Power: 15 Watts.
 4. Magnet Weight: 10 ounces.
 5. Single voice coil.
 - a. The unit shall come with a transformer having taps of 1/2, 1, 2 and 4 watts. All speakers shall be tapped at 1 watt. Provide Soundolier 61-8W speaker grille, EZ95-8 enclosure and support rail. Provide Soundolier C10A or Engineer approved equal speaker.
 - B. Flush mounted Wall speakers: Provide an 8" speaker as above with Soundolier 198-8 backbox and 161-8 matching grille.
 - C. Maintenance areas and outside horns (flush): Provide a Soundolier APF-15T flush mounted horn with multitap line matching transformer. Provide outside horns (weatherproof) with a Soundolier VP-161APF baffle (painted brown) and required back box. Indoor units shall have a L20-101 grille with L20-211 backbox.
 - D. Wall Mounted Volume Control: Provide a control that offers step attenuation via an autotransformer. The control shall work with either 25 volt or 70 volt lines and be rated at a minimum of 10 watts.
 - E. Surface Mounted Horn Speaker (in ceiling space) - Horn loudspeakers shall be a Soundolier APF-15T surface mount horn with multitap line matching transformer. Provide with each unit a Soundolier VP-161APF baffle and required back box in **Gymnasiums**.
 - F. Corridor Speakers: Provide same as classroom speakers.
 - G. Surface mounted (wall or exposed ceiling speakers): Provide same as classroom speaker, with required mounting grill for Soundolier L20-213 square surface mounted enclosure.
- 2.10 CONDUCTORS AND CABLES
- A. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but not smaller than No. 22 AWG.
 - B. Insulation: Thermoplastic, not less than 1/32 inch thick.
 - C. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 22 AWG tinned, soft-copper strands formed into a braid or equivalent foil.
 1. Minimum Shielding Coverage on Conductors: 60 percent.
 - D. Plenum Cable: Listed and labeled for plenum use.
 - E. Coordinate use of existing wiring with new equipment. Verify interoperability.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wiring Method: Install wiring in raceways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cables and raceways except in unfinished spaces.
- B. Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by J- hooks or similar fittings designed and installed to avoid damage to cables. Secure cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, or fittings.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess. Use lacing bars in cabinets.
- D. Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.
- E. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches for speaker microphones and adjacent parallel power and telephone wiring. Separate other school intercom and program equipment conductors as recommended by equipment manufacturer.
- F. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- G. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- H. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- I. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
- J. Connect wiring according to Division 26 Section "Conductors and Cables."
- K. Provide installation of all equipment specified, including all miscellaneous parts and labor for a complete, fully functioning system.

3.2 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

3.3 SYSTEM PROGRAMMING

- A. Programming: Fully train Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.4 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. Perform the following field tests and inspections and prepare test reports:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing school intercom and program equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Test originating station-to-station, all-call, and page messages at each intercom station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
 - 4. Frequency Response Test: Determine frequency response of two transmission paths, including all-call and paging, by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.
 - 5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure signal-to-noise ratio at paging speakers.
 - b. Repeat test for three speaker microphones, one master station microphone, and for each separately controlled zone of paging loudspeakers.
 - c. Minimum acceptable ratio is 45 dB.
 - 6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each intercom, paging, and all-call amplifier. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.
 - 7. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB; in levels between adjacent zones, plus or minus 5 dB.
 - 8. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.
 - 9. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Division 16 Section "Grounding and Bonding."

- C. Retesting: Correct deficiencies and retest. Prepare a written record of tests.
- D. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.
- E. Prepare written test reports.
 - 1. Include a record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service and initial system programming.
- B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
- C. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. 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 two visits to site outside normal occupancy hours for this purpose, without additional cost.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain school intercom and program equipment. Refer to Division 1 Section "Demonstration and Training."
 - 1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining equipment.

****END OF SECTION****

CLOCK AND PROGRAM SYSTEM

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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 work of this section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements."

1.2 SUBMITTALS

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: Indicate wiring diagrams and interconnection diagrams.
- C. Product Data: Provide for each item of equipment; show specified ratings and physical dimensions.

1.3 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 260010.
- B. Operation Data: Include the following:
 - 1. Instructions for starting and operating clock system.
 - 2. Instructions for operating system under unusual conditions following power failure or other condition requiring resetting of clocks.
 - 3. Operating limits which may result in hazardous or unsafe conditions, or in equipment damage.
 - 4. Routine preventive maintenance schedule.

- C. Maintenance Data: Include the following:
 - 1. List special tools, maintenance materials, and replacement parts.
 - 2. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
 - 3. Recommended cleaning methods, frequency, and materials.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install products until building is enclosed.
- B. Maintain conditions to manufacturer's instructions during and after installation of clock system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Digital Display Systems (Contact Barry Gilbert at Sound Engineering)

2.2 CLOCK AND PROGRAM SYSTEM

- A. Description: Provide time standard signal for indicating clocks, time period audible signals.
- B. Configuration: Synchronous wired.
- C. System Indicating Clock Capacity: quantity as shown on the drawings with 20% spare capacity.
- D. System Control Relay Capacity: as required.
- E. Program Circuit Capacity: 4.

2.3 MASTER CLOCK UNIT

- A. Manufacturer and Model:
 - 1. Digital Display Systems (existing master clock at Larson Middle School)
- B. Description: Programmable Master clock for maintaining standard time and transmitting time, correcting, and program control signals.

2.4 INDICATING CLOCKS

- A. Manufacturer and Model:
 - 1. Digital Display Systems model BFBW 41225 for dual face clocks, model BFBW 41225 for single face clocks.
- B. Description: 4" red digital LED display.
- C. Finish and Color: Black color housing.
- D. Voltage: 24 V, 60 Hz.
- E. Size: 4" LED display.

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- F. Backboxes: Provide per manufacturer's requirements.
- G. Provide wireguards for gymnasium applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide wireguards for clocks in gymnasiums.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems.

3.3 DEMONSTRATION

- A. Provide system demonstration covering all aspects of operation, maintenance and warranty service procedures.

3.4 WARRANTY

- A. Provide two year warranty. Include coverage of travel, parts and service.

****END OF SECTION****

FIRE ALARM

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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 work of this section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements."

1.2 SECTION INCLUDES

- A. Fire alarm and smoke detection systems. This section intends to describe a Protected Premises Fire Alarm System. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular with multiplex communication techniques, in full compliance with all

applicable codes and guidelines. The features and system capacities contained in this specification shall be furnished as part of this project.

- B. The system as described shall be installed, tested, and delivered to the Owner in first class condition. The system shall include all the required hardware and software to accomplish the requirements of this specification and the contract documents, whether or not specifically itemized herein.
- C. All equipment furnished shall be new and include the latest state of the art products from a single manufacturer, engaged in the manufacturing and sale of fire detection devices for over ten years. The equipment manufacturer shall have an installed base of existing systems as a reference.

1.3 REFERENCES

- A. NFPA 72 - National Fire Alarm Code.
- B. NFPA 101 - Life Safety Code.
- C. U.L. 1971 - Standard for Safety Signaling Devices for the Hearing Impaired.

1.4 REGULATORY REQUIREMENTS

- A. System: UL (FPED) and FM listed.
- B. Conform to requirements of NFPA 101.
- C. A.D.A. Federal guidelines.
- D. Conform to State of Michigan Fire Code.
- E. Conform to International Building Code.

1.5 SUMMARY

- A. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
 - 1. Fire Alarm and Detection Operations.
 - 2. Remote Monitoring of Sprinkler Systems.
 - 3. Remote Manual and Automatic Control of all Door Hold-open Devices, and other auxiliary functions indicated on the drawings.

1.6 SYSTEM DESCRIPTION

- A. General: Complete, zoned, noncoded, addressable, microprocessor-based fire detection and alarm system with manual and automatic alarm initiation, addressable analog initiating devices, and automatic alert.
- B. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate

system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel (FACP).

- C. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate future changes.
- D. Resident software shall allow for configuration of notification appliance and control circuits so that additional hardware shall not be necessary to accommodate changes.
- E. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history.
- F. Signal Transmission: Notification appliance circuits shall be NFPA Style Y, Class B. Signaling line circuits shall be NFPA Style 4, Class B.
- G. Data Communication Transmission Between Control Units: Style 7, Class A.

1.7 SYSTEM FUNCTIONS

- A. Signal Initiation: The manual or automatic operation of an alarm-Initiating or supervisory-operating device shall cause the FACP to transmit an appropriate signal including:
 - 1. General alarm.
 - 2. System trouble.
 - 3. Valve tamper supervisory.
 - 4. Door release.
 - 5. Fan shutdown.
 - 6. Release electrically held door locks.
 - 7. A general alarm shall be initiated by:
 - 8. Water-flow alarm switch operation.
 - 9. Smoke detection. Alarm verification is required for all smoke detector zones.
 - 10. Manual station operation.
 - 11. Heat detector operation.
- B. General Alarm: A system general alarm shall:
 - 1. Indicate the general alarm condition at the FACP.
 - 2. Identify the device that is the source of the alarm at the FACP.
 - 3. Display the alarm on an 80 character LCD display. The system alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control unit. The display shall show the new alarm information.

4. Sound a pulsing alarm tone within the FACP until the event has been acknowledged.
 5. Operate audible and visible alarm notification signals throughout the building.
 6. Sound a continuous fire alarm signal until silenced by the alarm silence switch at the FACP.
 7. Flash all visible alarm notification appliances continuously until the System Reset Switch is operated. Any subsequent zone alarm shall reactivate the alarm notification appliances.
 8. Close fire and smoke doors normally held open by magnetic door holders.
 9. Stop supply and return fans serving zone where alarm is initiated.
 10. Close smoke dampers on system serving zone where alarm is initiated.
 11. Transmit the alarm to the proprietary supervising station.
- C. A supervisory alarm shall be initiated by:
1. Sprinkler valve tamper switch operation.
- D. Loss of primary power at the FACP shall sound a trouble signal at the FACP and shall indicate at the FACP when the system is operating on an alternate power supply.
- E. Circuit Supervision: Circuit faults shall be indicated by means of both a zone and a trouble signal at the FACP.
- F. Annunciation: Manual and automatic operation of alarm and supervisory initiating devices shall be annunciated on the FACP, indicating the location and type of device.
- G. FACP Alphanumeric Display: Shall display plain-language description of alarms, trouble signals, supervisory signals, monitoring actions, system and component status, and system commands.
- H. Independent System Monitoring: Supervise each independent smoke detector, fire suppression system and duct detector, for both normal operation and trouble.
- I. Alarm Silencing: If the "Alarm Silence" button is pressed, all audio alarm signals shall cease operation.
- J. System Reset: The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied.
- K. Activation of an auxiliary bypass switch shall override the selected automatic functions.
- L. Auxiliary manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble. The "off normal" status shall be clearly identified in plain-language on the FACP.
- M. Recording of Events: Record all alarm, supervisory, and trouble events in non-volatile memory.
- N. Smoke Sensor Sensitivity Adjustment:
1. Authorized operation of controls at the FACP shall cause the selection of specific addressable smoke sensors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings.

2. Remote Controllability: Individually monitor sensors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP. The alarm decision for each sensor shall be determined by the control unit. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
- O. The actuation of the "enable one person test" program at the FACP shall activate the "One Person Testing" mode of the system which shall cause the following to occur:
1. The city circuit connection shall be bypassed.
 2. Control relay functions shall be bypassed.
 3. The FACP shall show a trouble condition.
 4. The alarm activation of any initiation device shall cause the audible notification appliances to code a number of pulses to match the zone number.
 5. The FACP shall automatically reset after signaling is complete.
 6. Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
 7. The system shall have the capacity of 8 programmable, passcode protected, one person testing groups, such that only a portion of the system need be disabled during testing.
- P. Power Requirements
1. The FACP shall receive 120 VAC power via a dedicated 20A branch circuit breaker provided with a red lock-on device.
 2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
 3. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.
 4. The incoming power to the system shall be supervised so that any power failure must be audibly and visibly indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
 5. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visibly indicated at the FACP and the command center.
- Q. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

1.8 SUBMITTALS

- A. Bidders will be required to submit shop drawings and product data during the construction phase of each project. Provide the following submittals for review:

1. Complete description data indicating UL listing for all network components. Include dimensioned plans and elevations showing minimum clearances and installed features and devices.
 2. Complete sequence of operation of all functions of the network that is project specific.
 3. A list of every address of every device connected to a panel that is provided for purposes of alarm initiating, status monitoring, supervised notification appliance circuits, and auxiliary control.
 4. A listing of the manufacturer's representatives responsible for installation coordination and service.
 5. Location of all controls, alarm actuating devices and notification appliance devices as shown on drawings.
 6. Wiring diagrams from manufacturer differentiating between factory-and field- installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring. Provide complete diagrams for all components and interfaces including equipment supplied by others.
 7. Operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.
 8. The manufacturer shall provide calculations for battery size as applicable. Battery size shall be a minimum 125% of the calculated requirement.
 9. Provide calculations for control modules indicating circuit loading with 20% spare capacity.
- B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of annotated Contract Drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, submit them for review. Make resubmissions if required to make clarifications or revisions to obtain approval.

1.9 PROJECT RECORD DOCUMENTS

- A. Submit as built drawings locating devices and conductor runs.
- B. Record of field tests of system.
- C. Submit manufacturer's certificate that system meets or exceeds specified requirements.

1.10 OPERATION, MAINTENANCE DATA, AND CALCULATIONS

- A. Provide to the Owner's representative operating instructions, maintenance, and repair procedures.
- B. After installation, include manufacturer representative's letter stating that system is operational.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage and handling of products will take place under the contract terms of each project in the construction phase of each project.

1.12 EXTRA MATERIALS

- A. Provide spare parts to the Owner's representative as noted below:
 - 1. Two keys of each type (for each project).
 - 2. Two smoke detectors (for each project).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. National Time & Signal (Expand the existing 902 FACP as required).

2.2 FIRE ALARM CONTROL PANEL (FACP).

- A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
- B. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of units as well as field wiring. Identify each enclosure by an engraved, red-laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1-inch high.
- C. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in modules. Construction requiring removal of field wiring for module replacement is not acceptable.
- D. Control Modules: Types and capacities required to perform all functions of the fire alarm systems plus 20% for future expansion. Local visible, and audible signals notify of alarm, supervisory, and trouble conditions
- E. Zones: Provide for all alarm and supervisory zones indicated.
- F. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm or trouble condition still exists.
- G. Alphanumeric Display and System Controls: Arrange to provide the basic interface between human operator at FACP and addressable system components, including annunciation, supervision, and control. A display with a minimum of 80 characters displays alarm, supervisory, and component status messages and indicates control commands to be entered into the system for control of smoke detector sensitivity and other parameters. Arrange keypad for use in entering and executing control commands.
- H. System power supplies including necessary transformers, regulators, filters and surge protection required for system operation.

- I. System processor, with internal operating system to process incoming alarm signals and issue output commands required as a result of the alarm signals and issue output. Total system response time shall not exceed 2.5 seconds on a system configured to the 3000 point capacity. All system processors shall be supervised by individual watchdog circuitry furnishing automatic restart after loss of activity. Systems with single watchdog circuits for all processors will not be accepted unless furnished with a standby CPU.
- J. Digital communications capabilities required for the control panel to communicate with remote panels annunciators and displays.
- K. A limited energy output circuit for operation of direct current (DC) audible or visual devices, leased line or city tie, shall be provided by a controllable signal module.
- L. Where control of operations requiring switching functions is indicated, there shall be provided a software controlled relay module.
 - 1. Motherboards shall be furnished as the system bus furnishing systems communications to the various plug in modules necessary for system operations.
- M. Remote Station Signal Transmitter: Electrically supervised, capable of transmitting contact I.D. and point annunciation signals over telephone lines to remote central station receiver. The electrical contractor shall provide a ¾" conduit with (2) dedicated telephone lines from the FACP to the telephone equipment.

2.3 REMOTE FIRE ALARM ANNUNCIATOR PANEL

- A. Provide remote annunciation and control using an 80 character, back-lit, alphanumeric, LCD readout. Alarm indication shall be identical to that at the main FACP including tone alert. Provide a minimum of four programmable control switches, alarm silence and system reset.
- B. Provide brushed aluminum trim plate.

2.4 EMERGENCY POWER SUPPLY

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.
- C. Magnetic door holders are not served by emergency battery power. Magnetic door holders are released after 15 seconds when normal power fails.

2.5 SMOKE DETECTORS, INTELLIGENT ADDRESSABLE

- A. Furnish and install where indicated on the drawings intelligent analog smoke detectors with features and characteristics as follows:
 - 1. Photoelectric detectors shall be listed for use as open area protective coverage, in duct installation and shall be insensitive to air velocity changes.

- a. The control panel shall provide a sensitivity readout for all detectors without removal from the pluggable base. Detectors not listed for sensitivity testing and logging from the control panel are not acceptable.
 - b. Detectors shall be operational with relay bases (as applicable), audible bases, and remote indicating LED's, programmable by the control panel and controlled by the detector electronics.
- B. Provide smoke detectors above fire alarm control panel, remote annunciator panels, and remote notification appliance power supply panels.
- C. Provide smoke detectors with auxiliary set of contacts where required.

2.6 THERMAL DETECTOR, INTELLIGENT ADDRESSABLE

- A. The intelligent thermal detectors shall be of the rate compensated fixed temperature type and shall be listed by Underwriters Laboratories, Inc. The intelligent thermal detectors shall be individually annunciated on the control panel. The intelligent thermal detectors shall contain an integral alarm lamp.

2.7 DUCT SMOKE DETECTORS

- A. The air duct detector shall be listed by Underwriters Laboratories, Inc. The air duct detector shall operate on a cross-sectional air sampling principle to overcome stratification and the skin effect. The air duct detector shall consist of a standard (intelligent/analog) photoelectric detector mounted in an air duct sampling assembly and sampling tube that protrudes across the duct of the ventilating system. The air duct detector shall retain the features of the intelligent/analog photoelectric detector, and be installed in the ventilating duct as indicated in the manufacturer's instructions. Provide with addressable control module. Relay based duct detectors not acceptable.
- B. The duct mounted detector shall have an auxiliary set of contacts in order for the temperature controls contractor to tie in the starter of the fans. Contacts shall be rated 1A, 120V.

2.8 DUCT SMOKE DETECTOR REMOTE ALARM INDICATORS

- A. Provide remote alarm indicator station for duct smoke detectors located above ceilings or in other locations above 10 feet and/or not readily accessible.
- B. Provide LED alarm indicator designed for mounting in a single gang coverplate.

2.9 MANUAL STATIONS, INTELLIGENT

- A. Provide single action intelligent manual stations where shown on the drawings, to be flush or surface mounted as required.
- 1. The manual stations shall be addressable and identifiable by the fire alarm control panel.
 - a. Address assignments shall be set mechanically or electronically and reside within the station in non volatile memory.

2.10 ADDRESSABLE INTERFACE MODULE

- A. Provide for integration of compatible two wire and shorting style contact devices into the analog signaling circuit. Intelligent analog signaling circuit interface module shall have the following capabilities:
1. Communication interaction with the analog signaling circuit having the capability of reporting alarm or trouble conditions from the devices monitored.
 2. Compatibility with ionization, photoelectric, and linear beam style smoke detectors, heat detectors, and all listed contact type devices.
 3. The module shall be addressable and identifiable by the control panel.
 - a. Address assignments shall be set mechanically or electronically and reside within the module in non volatile memory.
 4. Water Flow Switches: The water flow switches shall be provided by the mechanical contractor and wired by the electrical contractor. The switches shall be connected to the fire alarm system through the use of addressable interface modules.
 5. Tamper Switches: The tamper switches shall be provided by the mechanical contractor and wired by the electrical contractor. The switches shall be connected to the fire alarm system through the use of addressable interface modules.
 6. Provide addressable interface modules to uniquely identify each flow and tamper switch.

2.11 ADDRESSABLE CONTROL MODULE

- A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:
1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
 2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

2.12 AUDIO VISUAL DEVICES

- A. Alarm Strobes (Visual): Visual alarm signals shall be furnished with minimum light intensity of 15cd average (horizontal and vertical distribution listed in accordance with UL 1971) and meet A.D.A. 75cd minimum intensity at horizontal and vertical axis and shall comply with the following:
1. Xenon strobe with minimum repetition rate of 1 HZ, not exceeding 2 HZ and a maximum duty cycle of 40% with a pulse duration of .2 seconds.
 2. Unfiltered or clear white light not exceeding 1000 candela.
 3. Visual signals shall be mounted at 96 inches above finish floor level, or six inches below ceiling level whichever is lower in accordance with NFPA 72, 1996. Provide wall mounted or ceiling mounted devices, as indicated on plans.
 4. Visual signals shall flash in synchronization in all corridors and in rooms where more than one strobe is installed.

- B. Alarm Horns: The alarm horns shall be of the polarized 24 VDC type. The mechanisms shall contain an aerospace grade aluminum diaphragm, tempered and polished armature, and tungsten contact point, all housed in a red die-cast frame and grill assembly. Horns shall have an integral strobe light that will flash during an alarm. Horns shall have a minimum sound level of 93 dB at 10 feet.
- C. Combination notification appliances (horn/strobe) consist of factory-combined, audible and visual notification units in a single mounting assembly. Provide wall mounted or ceiling mounted devices, as indicated on plans.
- D. Audible devices shall be furnished to provide minimum of 15 db above ambient sound levels. Maximum sound levels shall not exceed 120 db, provisions shall be made to adjust the audible levels accordingly.

2.13 AUXILIARY DEVICES

- A. Door Release: Magnetic door holder with integral diodes to reduce buzzing, 24 VDC coil voltage.

2.14 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum

PART 3 - EXECUTION

3.1 WARRANTY

- A. All equipment and systems shall be warranted by the contractor for a period of two years following acceptance. The warranty shall include parts, labor, prompt field service, pick-up and delivery.
- B. Provide two years testing and maintenance, which shall consist of:
 - 1. Regularly and systematically examining all detectors, manual stations, panels, relays, pressure switches and accessories pertaining to the system.
 - 2. Regularly and systematically examine, adjust and clear all the electrical and mechanical components of water flow switches.

3. Tests and written reports which certify that all initiating devices have been tested and which indicate the result of the inspection test as required by the authority having jurisdiction.

3.2 TESTS AND REPORTS

- A. The contractor shall perform all electrical and mechanical tests required by the equipment manufacturer's certification form. In addition, they shall measure and adjust each of the ionization detectors to the maximum stable sensitivity setting. This must be performed with the detector at its operational location and under normal operational environmental conditions in the area. Bench settings are not acceptable. All test and report costs shall be in the unit price established for each device. A checkout report shall be prepared by the installation technicians and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report shall include, but not be limited to:
 1. A complete list of equipment installed and wired.
 2. Indication that all equipment is properly installed and functions and conforms with these specifications.
 3. Test of individual zones as applicable.
 4. Serial numbers, locations by zone and model number for each installed detector.
 5. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
 6. Response time on thermostats and flame detectors (if used).
 7. Technician's name, certificate number and date.
- B. After completion of all the tests and adjustments listed above, the contractor shall submit the following information to the Architect:
 1. "As-built" conduit layout diagrams including wire color code and/or tag number.
 2. Complete "as-built" wiring diagrams.
 3. Detailed catalog data on all installed system components.
 4. Copy of the test report.
- C. Final tests and inspection shall be held in the presence of engineer. The contractor shall supply personnel and required auxiliary equipment for this test without additional cost.
- D. The completed smoke detection system shall be tested to insure that it is operating properly. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period.
- E. Before final acceptance of work, the contractor shall deliver five copies of a composite "Operating and Shop Maintenance Manual." Each manual shall contain, but not be limited to: a statement of guarantee including date of termination and name and phone number of the person to be called in the event of equipment failure.
- F. Individual factory issued manuals shall contain all technical information on each piece of equipment installed. In the event such manuals are not obtainable from the factory, it shall be the

responsibility of the contractor to compile and include them. Advertising brochures or operational instructions shall not be used in lieu of the required technical manuals.

3.3 INSTALLATION

- A. Control and other panels shall be mounted with sufficient clearance for observation and testing.
- B. All fire alarm junction boxes must be clearly marked for easy identification as indicated in 16195. All wiring shall be in conduit unless noted otherwise on the contract documents or in the specifications. Flexible connectors shall be used for all devices mounted in suspended lay-in ceiling panels. All conduit, mounting boxes, junction boxes and panels shall be securely hung and fastened with appropriate fittings to insure positive grounding throughout the entire system.
- C. Fire alarm pull stations and horns installed in finished areas shall be mounted semi-flush and may be surface mounted in non-finished areas. Smoke detectors and thermal detectors shall be mounted on a recess mounted junction box in finished areas and to surface mounted junction boxes in non-finished areas.
- D. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be permitted in fire alarm conduits. Wiring splices are to be avoided to the extent possible, and if needed they must be made only in junction boxes and shall be crimp connected. Transposing or changing color coding of wires shall not be permitted. Wire nut-type connections are not acceptable. All conductors in conduit containing more than one wire shall be labeled on each end with "E-Z markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded. All controls, function switches, etc., shall be clearly labeled on all equipment panels. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
- E. Install manual station flush mounted with operating handle 48 inches maximum above floor. Install audible and visual signal devices no more than 96 inches above highest floor level within the space or 6 inches below the ceiling, whichever is lower.
- F. Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- G. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, panels, duct smoke detectors, and other auxiliary supervised devices.
- H. Automatic Detector Installation: NFPA 72.
- I. All gymnasiums and locker rooms fire alarm devices shall be provided with protective wire guards.
- J. Fire alarm system cable shall be plenum rated, with red outer coloring. All cable drops to devices shall be in conduit (concealed in walls). Cabling installed in open ceiling spaces shall be type FPLP, low smoke, fire resistant, with red coloring. Cabling shall be per manufacturer's recommendation, and shall be able to power the strobes and horn/strobes together, or independently.
- K. Install fire alarm cable in ceiling spaces to avoid damage. Use bridle rings and other similar means of support (lay-in ceiling areas).
- L. Cabling to the Fire Alarm Control Panel and drops to devices shall be in recessed conduit.
- M. Fire alarm cabling in exposed ceiling spaces and above drywall ceiling areas shall be in conduit. Conduit used for fire alarm system shall have couplings and junction boxes painted red.

****END OF SECTION****

BP19 - Bid Tab

	Base Bid Price	Bid Security (Y/N)	Finalist Disclosure and Item Form (Y/N)	Alternate A1: Larson - R&H Wall, Doors, & Frames	Alternate A2: Larson - R&H Doors B100A & B101A	Total with BOTH Alternates	Total with Alternate 1	Total with Alternate 2	Voluntary Alternates
General Trades									
City Contracting	\$299,000.00	Y	Y	\$12,000.00	\$7,000.00	\$318,000.00	\$311,000.00	\$306,000.00	
Herberg Contracting	\$299,900.00	Y	Y	\$31,500.00	\$4,750.00	\$326,150.00	\$321,400.00	\$294,650.00	
M.L. Schoenher Construction	\$281,600.00	Y	Y	\$9,000.00	\$3,640.00	\$295,040.00	\$293,400.00	\$285,240.00	Modercos in lieu of Modernfield - Deduct \$2,000

	Base Bid Price	Bid Security (Y/N)	Finalist Disclosure and Item Form (Y/N)	Total with all Alternates	Total with Highlighted Alternates	Voluntary Alternates
Mechanical						
Control Mechanical	\$54,000.00	Y	Y	\$54,000.00		

	Base Bid Price	Bid Security (Y/N)	Finalist Disclosure and Item Form (Y/N)	Total with all Alternates	Total with Highlighted Alternates	Voluntary Alternates
Electrical						
Great Lakes Power & Lighting	\$68,000.00	Y	Y	\$68,000.00		
Debonco Electric	\$188,500.00	Y	Y	\$188,500.00		