
**BIDDING DOCUMENTS
FOR THE**

**SAGINAW CHILDREN'S ZOO
CENTRAL RESTROOMS & CONCESSIONS BUILDING
SAGINAW, MI**

**SAGINAW ZOOLOGICAL SOCIETY
1730 S. WASHINGTON AVE.
SAGINAW, MI 48601**

Prepared By:
SPICER GROUP, INC.
SAGINAW, MICHIGAN
NOVEMBER 2022

Plans Included

DA-1431-1-40

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OWNER:
Saginaw Zoological Society
1730 S. Washington ave.
Saginaw, MI 48601

DESIGN PROFESSIONAL:
Spicer Group, Inc.
230 S. Washington Avenue
Saginaw, MI 48607

**SAGINAW CHILDREN'S ZOO
CENTRAL RESTROOM & CONCESSIONS BUILDING
SAGINAW, MICHIGAN**

INVATATION TO BID

Sealed Bids from General Contractors only (single prime contractor for all work), for the construction of the above referenced project will be received on **Thursday, December 8th no later than 5:00 PM** at the office of the Architect, Spicer Group, Inc. 230 S. Washington Ave., Saginaw, MI. 48607. Bids may be mailed, delivered in person, or e-mailed. The bids will be opened privately and tabulated within 5 business days. A tabulation of bids will be provided to all registered bidders that submitted a bid.

Project Scope: Construction of a new Central Restroom & Concessions Building for the Saginaw Children's Zoo. This building will be constructed of single wythe decorative concrete masonry units, standard concrete masonry units, wood framing with a single slope roof consisting of wood beams, wood framing and decking with a membrane roof. In addition to the Central Restrooms & Concessions building, will be a North Toilet Room addition to be constructed of standard concrete masonry units between two existing buildings. This building will have a double slopped roof made from engineered wood trusses and a standing seam metal roof. The North Toilet Room addition will be bid as an add alternate.

Each bid proposal shall be accompanied by the required bid form and all documents per the instructions to bidders available in the bidding documents.

The Owner reserves the right to waive an informality in any bid, to reject any or all bids, or accept any bid which is considered most favorable to the Owner, project duration will be considered.

A **MANDATORY** pre-bid conference/walk through will be held on **Thursday November 17th at 10:00 AM** at the project location **1730 S. Washington Ave, Saginaw, MI**. If you are unable to make this date, contact the Architect **prior to** November 17th to arrange a different date to view the location. Requests made on the day of or after the 17th will not be accepted.

Electronic copies of plans, proposal forms and specifications may be viewed beginning **November 11, 2022** by invitation only with a link to the bid site. Please do not share this link with sub-contractors or suppliers. Documents may be downloaded for a \$15.00 fee. Paper copies may be obtained for a deposit of \$200.00 at Spicer Group, 230 S. Washington Ave, Saginaw, MI 48607 upon request only. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

Use the Bid Form in the specifications for submittal of sealed bid. Any and all addenda will be emailed to registered plan holders only. The Contractor is responsible for ensuring all addenda have been received and acknowledged prior to submittal of the bid.

INSTRUCTIONS TO BIDDERS

THE PROJECT:

(Name and location or address)

Saginaw Children's Zoo
Central Restroom & Concessions Building
1730 S. Washington Ave.
Saginaw, MI 48601

THE OWNER:

(Name, legal status and address)

Saginaw Zoological Society
Nancy Parker, Zoo Director
1730 S. Washington Ave.
Saginaw, MI 48601

THE ARCHITECT:

(Name, legal status and address)

Spicer Group
230 S Washington Ave.
Saginaw, MI 48607
David W. Marr, AIA, NCARB Project Architect
989-921-5550 david.marr@spicergroup.com

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ARTICLE 1 DEFINITIONS

- 1.1** Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.
- 1.2** Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.
- 1.3** Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.
- 1.4** A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.5** The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.
- 1.6** An Alternate Bid (or Alternate) is an amount stated in the Bid 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.
- 1.7** A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.
- 1.8** A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.
- 1.9** A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

- 2.1** The Bidder by making a Bid represents that:

 - 2.1.1.** The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.
 - 2.1.2.** The Bid is made in compliance with the Bidding Documents.
 - 2.1.3.** The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

- 2.1.4. The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

ARTICLE 3 BIDDING DOCUMENTS

3.1 COPIES

- 3.1.1. Bidders may obtain complete sets of the Bidding Documents from the Architect – Spicer Group. A fee of \$200 will be required for printed sets of the drawings and specifications upon email request, and \$15 for those who receive the documents via Spicer bidding site. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.
- 3.1.2. Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the Advertisement or Invitation to Bid, or in supplementary instructions to bidders.
- 3.1.3. Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 3.1.4. The Owner and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

- 3.2.1. The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.
- 3.2.2. Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.
- 3.2.3. Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

3.3 SUBSTITUTIONS

- 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

- 3.3.2 No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- 3.3.3 If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.
- 3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

3.4 ADDENDA

- 3.4.1 Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.
- 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.
- 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.
- 3.4.4 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

- 4.1.1 Bids shall be submitted on the forms included with the Bidding Documents.
- 4.1.2 All blanks on the bid form shall be legibly executed in a non-erasable medium.
- 4.1.3 Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.
- 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid.
- 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

- 4.1.6** Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

4.2 BID SECURITY

- 4.2.1** A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.
- 4.2.2** The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.
- 4.2.3** The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 4.2.4** Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

4.3 SUBMISSION OF BIDS

- 4.3.1** All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.
- 4.3.2** Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.
- 4.3.3** The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.
- 4.3.4** Bids will be received in hard copy at Spicer Group, 230 S Washington Ave., Saginaw,

MI 48607 no later than the date and time listed in the invitation to bid. Email bids will be accepted in PDF form sent to david.marr@spicergroup.com and time stamped no later than the date and time listed in the invitation to bid. List the project name in the subject line.

- a. The contractor with the successful bid, if submitted electronically, will produce the original signed hard copies to the architect within three business days.

4.4 MODIFICATION OR WITHDRAWAL OF BID

4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.

4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date- and time-stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worded as not to reveal the amount of the original Bid.

4.4.3 Withdrawn Bids may be resubmitted up to the date and 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, if required, shall be in an amount sufficient for the Bid as resubmitted.

ARTICLE 5 CONSIDERATION OF BIDS

5.1 OPENING OF BIDS

At the discretion of the Owner, if stipulated in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be privately opened and will be tabulated. An abstract of the Bids may be made available to Bidders.

5.2 REJECTION OF BIDS

The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security (if any) or by other data required by the Bidding Documents, or a Bid which is in any way incomplete, or irregular is subject to rejection.

5.3 ACCEPTANCE OF BID (AWARD)

5.3.1 It is the intent of the Owner to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's own best interests.

5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless

otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted. Project time frame will also be taken into consideration.

ARTICLE 6 POST-BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT (NOT REQUIRED FOR THIS PROJECT)

~~Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.~~

6.2 OWNER'S FINANCIAL CAPABILITY (NOT REQUIRED FOR THIS PROJECT)

~~The Owner shall, at the request of the Bidder to whom award of a Contract is under consideration and no later than seven days prior to the expiration of the time for withdrawal of Bids, furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. Unless such reasonable evidence is furnished, the Bidder will not be required to execute the Agreement between the Owner and Contractor.~~

6.3 SUBMITTALS

6.3.1 The Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, after notification of selection for the award of a Contract, furnish to the Owner through the Architect in writing:

- .1** a designation of the Work to be performed with the Bidder's own forces;
- .2** names of the manufacturers, products, and the suppliers of principal items or systems of materials and equipment proposed for the Work; and
- .3** names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder in writing if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, (1) withdraw the Bid or (2) submit an acceptable substitute person or entity with an adjustment in the Base Bid or Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

- 7.1.1** If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources.
- 7.1.2** If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.
- 7.1.3** If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

7.2 TIME OF DELIVERY AND FORM OF BONDS

- 7.2.1** The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.
- 7.2.2** Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.
- 7.2.3** The bonds shall be dated on or after the date of the Contract.
- 7.2.4** The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a Stipulated Sum along with AIA document A201 General Conditions to the Contract. The contractor shall secure the official AIA documents and prepare them for owner's review.

END OF SECTION

BID FORM
(Proposal)

A. **PROJECT IDENTIFICATION:** Saginaw Children’s Zoo, Central Restrooms & Concessions Building

B. **CONTRACT IDENTIFICATION AND NUMBER:** Spicer Project No. 131928SG2022

C. **THIS BID IS SUBMITTED TO:** Saginaw Zoological Society
1730 S. Washington Ave.
Saginaw, MI., 48601

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in the Contract Documents for the Bid Price and within the Bid Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.
2. BIDDER accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance during the Bid hold period. BIDDER will sign and deliver the required number of counterparts of the Agreement with the Bonds and other documents required by the Bidding Requirements within fifteen days after the date of OWNER's Notice of Award.
3. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:
 - a. BIDDER has examined copies of all the Bidding Documents and of the following Addenda. There is no Addendum Acknowledgment sheet; therefore, please acknowledge receipt of Addenda below:

(BIDDER NOTE: Bidder shall fill in date and number of all addenda. As an alternative, Bidder may submit signed copies of Addendum. If no addenda have been issued, insert "N/A".)

Date of Issue	Addendum No.
_____	_____
_____	_____
_____	_____

- b. BIDDER has visited the site and conducted an examination of the area and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance and furnishing of the Work.
 - c. BIDDER is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress, performance and furnishing of the Work.

- d. BIDDER has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site. BIDDER acknowledges that such reports and drawings are not Contract Documents and may not be complete for BIDDER's purposes. BIDDER acknowledges that OWNER and Professional do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the site. BIDDER has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by BIDDER and safety precautions and programs incident thereto. BIDDER does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price and other terms and conditions of the Contract Documents.
- e. BIDDER is aware of the general nature of Work to be performed by OWNER and others at the site that relates to Work for which the Bid is submitted as indicated in the Contract Documents.
- f. BIDDER has correlated the information known to BIDDER, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.
- g. BIDDER has given PROFESSIONAL written notice of all conflicts, errors, ambiguities or discrepancies that BIDDER has discovered in the Contract Documents and the written resolution thereof by PROFESSIONAL is acceptable to BIDDER, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.
- h. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

This Portion intentionally left blank

4. BIDDER will complete the Work in accordance with the Contract Documents for the following prices(s):

LUMP SUM BID

Item No.	Description	Unit Price	Amount
1	General Conditions, P&O	LS	\$ _____
2.	Architectural, including specialties	LS	\$ _____
3.	Plumbing	LS	\$ _____
4.	Mechanical	LS	\$ _____
5.	Electrical	LS	\$ _____
6.	Site Work	LS	\$ _____
Total Amount			\$ _____

Total Amount of bid: _____
Written

ADD ALTERNATE #1: All site, structural, architectural, electrical, mechanical, and plumbing elements related to the construction of the North Toilet Room Addition shall be priced as a single lump sum. \$ _____

5. All specific cash allowances are included in the price(s) set forth above and have been computed in accordance with paragraph 11.8 of the General Conditions.

5. BIDDER agrees that the Work:

a. will be substantially complete within _____ calendar days after the date when the Contract Times commence to run as provided in paragraph 2.3 of the General Conditions and completed and ready for final payment in accordance with paragraph 14.13 of the General Conditions within _____ calendar days after the date when the Contract Times commence to run.

6. In addition, BIDDER accepts:

a. That the CONTRACTOR shall be responsible for laying out (staking) the works sufficient for construction purposes in accordance with applicable parts of paragraph 4.4 of the General Conditions and the Supplementary Conditions. Spicer Group may be contracted by the contractor to perform staking for a fee. *****NOTE - CONTRACTOR RESPONSIBLE FOR STAKING*****

b. That all inspection and observation of the work deemed necessary by the PROFESSIONAL and as required by the OWNER shall be performed by a third-party testing/inspection firm(s) specializing in construction testing and inspection, and will be paid for by the BIDDER.

7. The following documents are attached to and made a condition of this Bid:
- a. A tabulation of Subcontractors, suppliers and other persons or organizations whose separate/individual work value exceeds 15% required to be identified in this bid.
 - c. BIDDER's Qualification Statement with supporting data.
8. Communications concerning this Bid shall be addressed to: David Marr, AIA, NCARB Project Manager, Spicer Group Saginaw, MI (989)-921-5550, david.marr@spicergroup.com
9. Terms used in this Bid which are defined in the General Conditions or Instructions will have the meanings indicated in the General Conditions or Instructions.
10. Dated and signed at _____ State of _____
 this _____ day of _____ 20____.
- Name of Bidder: _____
- By: _____
 (Authorized Officer's Name)
- Its: _____
 (Officer's Title)
- Business Address: _____

 (Zip Code)
- Telephone Number: (____) _____ Fax Number: (____) _____
- Federal I.D. Number: _____

THIS SECTION LEFT BLANK

CONTRACT EXECUTION: The Above signed agrees to execute a contract for work covered by this proposal provided that notification of its acceptance is within sixty (60) calendar day after opening of the proposal (bid).

The Above signed hereby declares that he/she has the legal status checked below:

<input type="checkbox"/> Individual: Name:	_____
<input type="checkbox"/> Partnership: Names:	_____ _____ _____ _____
<input type="checkbox"/> Corporation: Incorporated Under the Laws of the State of:	Corporate Seal _____
<input type="checkbox"/> Joint Venture: Names:	Signatures _____ _____ _____ _____

(Each joint venturer must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above).

INSURANCE COVERAGES

The insurance required by Article 5 of the General Conditions shall be for the following coverages and shall be not less than the following amounts or greater where required by Laws and Regulations but shall not prevent the CONTRACTOR from requiring additional coverage is necessary and prudent for the particular situation.

<u>WORKERS' COMPENSATION</u>	<u>MINIMUM LIMITS(000's)</u>
Part One: Compensation	Statutory
Part Two: Employers' Liability:	
accident	\$ 1,500
disease	\$ 500
aggregate disease	\$ 1,500

COMMERCIAL GENERAL LIABILITY

General Aggregate Limit	\$3,000
Products/Completed Operations Aggregate Limit	\$3,000
Personal/Adverse Injury	\$1,500
Each Occurrence Limit	\$1,500

COMPREHENSIVE AUTOMOBILE LIABILITY

Bodily Injury-Each Occurrence Limit	\$ 500
Property Damage-Each Occurrence Limit	\$ 250

OR

Combined Single Limit	\$1,500
No Fault	Statutory

OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY

Aggregate Limit	\$1,500
Each Occurrence Limit	\$1,000

OR

In lieu of the Owner's and Contractor's Protective Liability, the Contractor may provide an endorsement to their policy for a per project aggregate coverage with the following limits:

Aggregate Limit	\$1,500
Each Occurrence Limit	\$1,000
(ISO form CG2503 or it's equivalent)	

A copy of this endorsement must accompany the Certificate of Insurance, the Certificate will clearly state the additional insured requirement and the policy contains the per project aggregate endorsement.

UMBRELLA or EXCESS LIABILITY

\$2,000

Insurance required by paragraphs 5.4.3 through 5.4.6 inclusive of the General Conditions shall name as named additional insureds:

Spicer Group, Inc.
Saginaw Zoological Society

BUILDER'S RISK INSURANCE

During the term of the contract, the contractor should maintain in force and at its own expense, builder's risk and/or installation floater insurance that covers labor, materials and equipment to be used for completion of the work performed under the contract. The insurance should cover all risks of direct physical loss at an amount equal to the full value of the contract improvements.



AIA Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

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)

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

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

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

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

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement.

AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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

EXHIBIT A 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 a Modification, 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:

(Check one of the following boxes.)

- The date of this Agreement.
- A date set forth in a notice to proceed issued by the Owner.
- Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

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

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

(Check one of the following boxes and complete the necessary information.)

- Not later than () calendar days from the date of commencement of the Work.

By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
-----------------	-----------------------------

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

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 (\$), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
------	-------

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement. (Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance
------	-------	---------------------------

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price
------	-------

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

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

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued 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:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than () days after the Architect receives the Application for Payment.

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

§ 5.1.4 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. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 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.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 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; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 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 Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect’s final Certificate for Payment, or as follows:

§ 5.3 Interest

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.)

_____ % _____

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the 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 Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

- Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- Litigation in a court of competent jurisdiction
- Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, 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.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner’s convenience.)

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner’s representative:

(Name, address, email address, and other information)

§ 8.3 The Contractor’s representative:

(Name, address, email address, and other information)

§ 8.4 Neither the Owner’s nor the Contractor’s representative shall be changed without ten days’ prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date
--------	-------	------

.6 Specifications

Section	Title	Date	Pages
---------	-------	------	-------

.7 Addenda, if any:

Number	Date	Pages
--------	------	-------

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

.8 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

- AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

The Sustainability Plan:

Title	Date	Pages
-------	------	-------

Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
----------	-------	------	-------

.9 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

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

OWNER (Signature)

CONTRACTOR (Signature)

(Printed name and title)

(Printed name and title)



AIA[®] Document A201[®] – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

THE OWNER:

(Name, legal status and address)

THE ARCHITECT:

(Name, legal status and address)

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

For guidance in modifying this document to include supplementary conditions, see AIA Document A503[™], Guide for Supplementary Conditions.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining

provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building

information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the

site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's

capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes

remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

- 3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the

time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under

Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the

Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate

Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The

Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable

by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The

foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers

to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not

constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the

endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The

Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the

Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section

15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly

consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

Sample

NOTICE OF AWARD

_____ Dated:

TO: _____
(BIDDER)

ADDRESS: _____

PROJECT: _____

OWNER's CONTRACT NO.: _____

CONTRACT FOR: _____
(Insert name of Contract as it appears in the Bidding Documents)

You are notified that your Bid dated _____ for the above Contract has been considered. You are the apparent Successful Bidder and have been awarded a contract for _____

(Insert total Work, alternates or sections or Work awarded)

The Contract Price of your contract is _____

(\$ _____).

_____ copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award.
_____ sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within **ten** days of the date of this Notice of Award, that is by:

1. You must deliver to Spicer Group, Inc. 3 fully executed counterparts of the Agreement including the Construction Performance Bond, the Construction Payment Bond, and the Certificates of Insurance.
2. You must deliver with the executed Agreement the Contract Security (Bonds) as specified in the Instructions to Bidders (paragraph 18) and General Conditions (paragraph 5.1).

Failure to comply with these conditions within the time specified will entitle OWNER to consider your bid in default, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten days after you comply with the above conditions, OWNER will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

SPICER GROUP, INC. on behalf of

Saginaw Zoological Society
(OWNER)

By: _____
(Project Manager. - SGI)

(TITLE)

ACCEPTANCE OF AWARD

By: _____
(CONTRACTOR)

(TITLE)

(DATE)

NOTICE TO PROCEED

Dated: _____, 20____

TO: _____
(CONTRACTOR)

ADDRESS: _____

PROJECT: _____

OWNER's CONTRACT No.: _____

CONTRACT FOR: _____

(Insert name of contract as it appears in the bidding documents)

You are notified that the contract Times under the above contract will commence to run on _____, 20____. By the date, you are to start performing your obligations under the contract Documents. In accordance with Article 3 of the Agreement the dates of Substantial completion and completion and readiness for final payment are _____, 20____ and _____ 20____.

Before you may start any Work at the site, the General conditions provides that you and Owner must each deliver to the other (with copies to PROFESSIONAL and other identified additional insureds) certificates of insurance which each is required to purchase and maintain in accordance with the contract Documents.

Also before you may start any Work at the site, you must:

(add other requirements)

Saginaw Zoological Society
(OWNER)

By:
(AUTHORIZED SIGNATURE)

(TITLE)

By:
(CONTRACTOR)

(AUTHORIZED SIGNATURE)

(TITLE)

(DATE)

ACCEPTANCE OF AWARD

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Contract description.
 - 2. Contractor's use of Site
 - 3. Work sequence.
 - 4. Owner occupancy.
 - 5. Permits.
 - 6. Specification conventions.

1.2 CONTRACT DESCRIPTION

- A. The Contractor shall furnish all the labor, material and construction equipment and perform all the work for this project as shown on the Drawings and described in the specifications prepared by Spicer Group, Inc. Contractor shall be responsible for the entire work until completed and accepted by the Owner.

1.3 CONTRACTOR'S USE OF SITE

- A. Limit use of Site to allow:
 - 1. Owner occupancy.
 - 2. Use of site by Public.

1.4 WORK SEQUENCE

- A. Construct Work in a positive direction during the construction period, coordinate construction schedule and operations with Engineer.

1.5 OWNER OCCUPANCY

- A. Schedule and substantially complete designated portions of the Work for occupancy before Substantial Completion of the entire Work.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

1.6 PERMITS

- A. Furnish necessary permits for construction of Work.

1.7 SPECIFICATION CONVENTIONS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases. END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cash allowances.
- B. Application for Payment.
- C. Change procedures.
- D. Defect assessment.
- E. Unit prices.

1.2 ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts; delivery to Site and applicable taxes unless stated otherwise in Allowance Schedule.
- B. Costs Not Included in Cash Allowances but Included in Contract Sum/Price: Product handling at Site including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing unless stated otherwise in Allowance Schedule.
- C. Engineer Responsibilities:
 - 1. Consult with Contractor for consideration and selection of products suppliers and installers.
 - 2. Select products in consultation with Owner and transmit decision to Contractor.
 - 3. Prepare Change Order.
- D. Contractor Responsibilities:
 - 1. Assist Engineer in selection of products, suppliers.
 - 2. Obtain proposals from suppliers and installers and offer recommendations.
 - 3. Upon notification of selection by Engineer and Owner execute purchase agreement with designated supplier.
 - 4. Arrange for and process Shop Drawings, Product Data, and Samples. Arrange for delivery.
 - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.

1.3 APPLICATION FOR PAYMENT

- A. Contractor will prepare progress payments in accordance with the Payment Schedule shown in the Agreement. Progress payments shall be submitted in AIA Document G702 and G703.
- B. Format will follow the itemized bid in the Proposal.

- C. Contractor shall submit waivers for each progress payment in accordance with the General Conditions.
- D. Payment will be subject to retainage as set forth in Public Act No. 524.

1.4 CHANGE PROCEDURES

- A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.
- C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.
- D. Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing a field order.
- E. Engineer may issue a Bulletin or Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and Specifications. Contractor will prepare and submit estimate within (2) two days.
- F. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change and the effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on the Work.
- G. Stipulated Sum/Price Change Order: Based on Bulletin or Notice of Change and Contractor's price quotation and Contractor's request for Change Order as approved by Engineer.
- H. Unit Price Change Order: For Contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of that which are not predetermined, execute Work under Work Directive Change. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.
- I. Work Directive Change: Engineer may issue directive, signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- J. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- K. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.

- L. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.
- M. Change Order Forms: Architects/Engineer's Form.
- N. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.
- C. Authority of Engineer and Owner to assess defects and identify payment adjustments is final.
- D. Nonpayment for Rejected Products: Payment will not be made for rejected products.

1.6 UNIT PRICES

- A. Authority: Measurement methods are delineated in individual Specification Sections.
- B. Measurement methods delineated in individual Specification Sections complement criteria of this Section. In event of conflict, requirements of individual Specification Section govern.
- C. Engineer will take measurements and compute quantities accordingly. Provide assistance in taking of measurements.
- D. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only. Actual quantities provided shall determine payment.
- E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.
- F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- G. Measurement of Quantities:
 - 1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
 - 3. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
 - 4. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
 - 5. Measurement by Area: Measured by square dimension using mean length and width or radius.

6. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
7. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Product options.
- C. Product substitution procedures.

1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Owner.

1.3 PRODUCT OPTIONS

- A. See Section 01 60 00 - Product Requirements.

1.4 PRODUCT SUBSTITUTION PROCEDURES

- A. Engineer will consider requests for substitutions only within **15** days after date of Owner-Contractor Agreement.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
 - 1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
 - 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
 - 3. Reference to Article and Paragraph numbers in Specification Section.
 - 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
 - 5. Changes required in other Work.
 - 6. Availability of maintenance service and source of replacement parts as applicable.
 - 7. Certified test data to show compliance with performance characteristics specified.
 - 8. Samples when applicable or requested.
 - 9. Other information as necessary to assist Engineer's evaluation.

- D. A request constitutes a representation that Contractor:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for substitution as for specified product.
 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
 6. Will reimburse Owner for review or redesign services associated with reapproval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
1. Submit requests for substitutions.
 2. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
 3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 4. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Field Engineering
- C. Cutting and Patching
- D. Preconstruction meeting.
- E. Site mobilization meeting.
- F. Progress meetings.
- G. Preinstallation meetings.
- H. Closeout meeting.
- I. Alteration procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Owner Contract Agreement to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- D. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
- E. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

1.3 ALLOWANCES

- A. Control datum for survey is that established by Owner provided survey shown on Drawings.
- B. Engineer will provide construction staking. Call the Engineer to request staking at least 3 working days in advance of the time needed for the work.

- C. Construction stakes removed or damaged by Contractor shall be replaced at Contractor's expense.
- D. When finished surfaces are cut so that a smoother transition and new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer.
- E. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a smooth transition for Engineer review and request instructions from Engineer.
- F. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- G. Finish surfaces as specified in individual product sections.
- H. Where there are changes in open drain cross sections, excavate a 20-foot smooth transition between sections.

1.4 CUTTING AND PATCHING

- A. Coordinate with Engineer 48 hours prior to cutting and patching.
- B. Employ skilled and experienced installer to perform cutting and patching.
- C. Submit written request in advance of cutting or altering elements which affects:
 1. Structural integrity of element.
 2. Integrity of weather-exposed or moisture-resistant elements.
 3. Efficiency, maintenance, or safety of element.
 4. Visual quantities of sight-exposed elements.
 5. Work of Owner or separate contractor.
- D. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 1. Fit the several parts together, to integrate with other Work.
 2. Uncover Work to install or correct ill-timed Work.
 3. Remove and replace defective and non-conforming Work.
 4. Remove samples of installed Work for testing.
- E. Execute work by methods which will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.
- F. Cut rigid materials using masonry saw or core drill.
- G. Restore Work with new products in accordance with requirements of Contract Documents.
- H. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
- J. Identify any hazardous substance or condition exposed during the Work to the Engineer for decision or remedy.

1.5 PRECONSTRUCTION MEETING

- A. Engineer will schedule and preside over meeting after Notice of Award.
- B. Attendance Required: Engineer, Owner, appropriate governmental agency representatives, applicable public and private utility companies and Contractor, subcontractors to be utilized on the project.

1.6 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work, if required.
- B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.
- C. Attendance Required: Job superintendent, major Subcontractors, Contractors and suppliers, and Engineer, Owner, as appropriate to agenda topics for each meeting.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 ALTERATION PROCEDURES

- A. Entire facility will be occupied for normal operations during progress of construction. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage.
 - 1. Perform Work not to interfere with operations of occupied areas.
 - 2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
 - 3. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.
- B. Materials: As specified in product Sections.
- C. Employ skilled and experienced installer to perform alteration and renovation Work.
- D. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion. Comply with Section 01 70 00 - Execution and Closeout Requirements
- E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- F. Remove debris and abandoned items from area and from concealed spaces.
- G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.
- H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.

- I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to original or specified condition.
- J. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified or new condition for each material, with neat transition to adjacent finishes.
- K. Where new Work abuts or aligns with existing Work, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- L. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Engineer for review.
- M. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition to Engineer for review.
- N. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- O. Finish surfaces as specified in individual product Sections.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Construction progress schedules.
- D. Proposed product list.
- E. Product data.
- F. Shop Drawings.
- G. Samples.
- H. Other submittals.
- I. Test reports.
- J. Certificates.
- K. Manufacturer's instructions.
- L. Manufacturer's field reports.
- M. Erection Drawings.
- N. Contractor review.
- O. Engineer review.
- P. MDOT Mix Design.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer-accepted form.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project, and deliver to Engineer. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- H. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- I. Allow space on submittals for Contractor and Engineer review stamps.
- J. When revised for resubmission, identify changes made since previous submission.
- K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule in duplicate within 15 days after date established in Notice to Proceed for Engineer and Owner review.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Submit horizontal bar chart with separate line for each major section of Work or operation, identifying first workday of each week.
- E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- F. Indicate estimated percentage of completion for each item of Work at each submission.
- G. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and under Allowances.

1.5 PROPOSED PRODUCT LIST

- A. Within 5 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.6 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit number of copies Contractor requires, plus three copies Engineer will retain.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.7 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit number of opaque reproductions Contractor requires, plus two copies Engineer will retain.
- E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.8 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Engineer for aesthetic, color, and finish selection.
 - 2. Submit Samples of finishes, textures, and patterns for Engineer selection.

- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.
- H. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.9 OTHER SUBMITTALS

- A. Closeout Submittals: Comply with Section 01 70 00 - Execution and Closeout Requirements.
- B. Informational Submittal: Submit data for Engineer's knowledge for Owner.
- C. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

1.10 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.11 CERTIFICATES

- A. Informational Submittal: Submit certification when specified in individual specification sections from manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

1.12 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.

- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.13 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge for Owner.
- B. Submit report in duplicate within 5 days of observation to Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.
- D. Identify conflicts between manufacturer's instructions and Contract Documents.

1.14 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.15 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
 - 1. Determination and verification of materials including manufacturer's catalog numbers.
 - 2. Determination and verification of field measurements and field construction criteria.
 - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
 - 4. Determination of accuracy and completeness of dimensions and quantities.
 - 5. Confirmation and coordination of dimensions and field conditions at Site.
 - 6. Construction means, techniques, sequences, and procedures.
 - 7. Safety precautions.
 - 8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.16 ENGINEER REVIEW

- A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to

perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner and Contractor.

- B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Field Samples.
- E. Labeling.
- F. Testing and inspection services.
- G. Bench marks and control elevations.
- H. Manufacturers' field services.

1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, requires clarification from Engineer before proceeding.
- D. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work using persons qualified to produce required and specified quality.
- F. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- G. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.
- H. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 FIELD SAMPLES

- A. Acceptable samples represent a quality level for the Work.

1.6 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.7 TESTING AND INSPECTION SERVICES

- A. Contractor will employ and pay for services of Engineer to perform materials inspection and testing including compaction.

- B. Then Engineer will perform inspections, tests, and other services specified in individual specification sections and as required.
- C. Reports will be submitted by Engineer, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. Cooperate with the Engineer; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - 1. Make arrangements with the Engineer and pay for additional samples and tests required for Contractor's use.
- E. Retesting required because of non-conformance to specified requirements shall be performed by the same Engineer. Payment for retesting will be charged to the Contractor.

1.8 BENCHMARKS AND CONTROL ELEVATIONS

- A. Elevations for proposed work shall be from bench marks established for this project.
- B. Verify elevations of existing features against project benchmarks.
- C. Notify Engineer of conflicts in elevations, which affect the proposed work.

1.9 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment commissioning and as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer.
- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.
- D. Refer to Section 01 33 00 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Electricity:
- B. Construction Facilities:
 - 1. Parking.
 - 2. Progress cleaning and waste removal.
 - 3. Fire-prevention facilities.
- C. Temporary Controls:
 - 1. Barriers.
 - 2. Water control.
 - 3. Dust control.
 - 4. Erosion and sediment control.
 - 5. Noise control.
 - 6. Pest and rodent control.
 - 7. Pollution control.
- D. Removal of utilities, facilities, and controls.
- E. Protection of Installed Work.
- F. Protection of Existing.
- G. Progress Cleaning.

1.2 TEMPORARY ELECTRICITY

- A. Provide and pay for power service required from utility source as needed for construction operation.
- B. Complement existing power service capacity and characteristics as required for construction operations.
- C. Provide power outlets with branch wiring and distribution boxes located as required for construction operations. Provide suitable, flexible power cords as required for portable construction tools and equipment.
- D. Provide main service disconnect and overcurrent protection at convenient location switch at source distribution equipment meter.
- E. Permanent convenience receptacles may be used during construction.

1.3 PARKING

- A. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.
 - 2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.
- B. Removal, Repair:
 - 1. Remove temporary materials and construction at Substantial Completion.
 - 2. Remove underground Work and compacted materials to depth of 2 feet fill and grade Site as indicated.
 - 3. Repair existing and permanent facilities damaged by use, to original condition.
- C. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.4 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, before enclosing spaces.
- C. Broom and vacuum clean interior areas before starting surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from Site and dispose of off-Site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.5 FIRE-PREVENTION FACILITIES

- A. Prohibit smoking within buildings under construction and demolition. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
- B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Standpipes: Maintain existing standpipes in usable condition to height within one floor of floor being demolished.
- D. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
 - 1. Provide one fire extinguisher at each stairway on each floor of buildings under construction and demolition.
 - 2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.

3. Provide minimum of one fire extinguisher on roof during roofing operations using heat-producing equipment.

1.6 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building.
 1. Barricade Construction: As indicated on Drawings.
 2. Covered Walkway Construction: As indicated on Drawings.
- C. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.
 1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
 2. Provide 6 foot-high barriers around drip line, with access for maintenance.
 3. Replace trees and plants damaged by construction operations.
- D. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.
- E. Provide access to all adjacent buildings for use during construction.

1.7 WATER CONTROL

- A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.
- B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.
- C. Trenches shall be dewatered to provide a stable base for structures and piping.

1.8 DUST CONTROL

- A. Execute Work by methods that minimize raising dust from construction operations.
- B. Provide positive means to prevent airborne dust from dispersing into atmosphere and into Owner-occupied areas.

1.9 EROSION AND SEDIMENT CONTROL

- A. Conform to Part 91 of Public Act 451 of 1994, relative to Soil Erosion and Sedimentation Control for the life of the project.
- B. Minimize amount of bare soil exposed at one time.
- C. Provide temporary measures such as berms, dikes, and drains to prevent sediment from entering adjacent waterways.
- D. Do not deposit trash, debris, or sediment in tile or open drains.

- E. Immediately repair trenches located within the traveled surface of roadways.
- F. Landscape construction areas as soon as practical after work is complete according to Sections 32 91 19 – Landscape Grading, 32 92 19 – Seeding.

1.10 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.11 PEST AND RODENT CONTROL

- A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work and entering facility.
- B. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.12 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials before Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 4 feet. Grade Site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary Work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.
- E. A sufficient sum of money to remove and replace or repair any utilities damaged or relocated during the construction of the project shall be included in total contract amount.

1.14 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Prohibit traffic from landscaped areas.

1.15 PROTECTION OF EXISTING

- A. CALL “MISS DIG” 811 or (1-800-482-7171) A MINIMUM OF THREE WORKING DAYS PRIOR TO CONSTRUCTION.
- B. Obtain a copy of Positive Response. Contact Miss Dig for additional assistance if there are any utilities not marked or cleared through the Positive Response System.
- C. Contact Miss Dig for additional assistance if there is a discrepancy in the field from the Positive Response System.
- D. Contact Miss Dig for additional assistance if utility is not found within the applicable “approximate locations” marked in the field.
- E. Protect landscaped areas. Damaged areas shall be replaced in kind.
- F. Protect utilities encountered during the work. Replace or repair damaged utilities.
- G. Protect drives, roadways, and sidewalks. Repair as required in following sections.
- H. Protect mailboxes. Relocate temporarily until mailboxes can be returned to original location. All mail boxes and posts must be returned to their original condition or better at no additional cost to the project.
- I. Protect trees, shrubs, and bushes:
 - 1. Where trees, shrubs, and bushes are too large to be replaced in kind, the proposed utility shall be installed in a boring or tunneling operation unless written consent is given by the property owner for removal. Owner and Engineer shall each be given one copy of consent letters.
 - 2. Where requested by the Property Owner, timber from removed trees shall be cut into 6 foot lengths and stockpiled along the work or as specified in the consent letter.
 - 3. Proper disposal of removed trees or sections of removed trees not wanted by the property owner shall become the responsibility of the Contractor.
 - 4. Trees, shrubs, and bushes that are removed and replaced shall be transplanted by an established nursery.
- J. Utilities must remain in service. If it becomes necessary to interrupt a utility service, the utility authority must be notified immediately and steps taken to restore temporary or permanent service as soon as possible.
- K. Maintain outlets for drains. Provide temporary pumping if necessary.
- L. Expose utility mains and services by hand in the trench.
- M. Where utility and drainage piping crosses the trench, support the piping according to the utility authority’s standards and backfill to the top with compacted sand.

1.16 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

- B. Clean road surface daily to the Owner's and/or Engineer's satisfaction.
- C. Complete leveling, remove excess material and debris and restore drainage not more than 1000 feet behind construction.
- D. A sufficient sum of money to remove and replace or repair any utilities damaged or relocated during the construction of the project shall be included in total contract amount.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Domestic Products: Except where specified otherwise, domestic products are required and interpreted to mean products mined, manufactured, fabricated, or produced in United States or its territories.
- E. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- F. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.

- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 25 00 - Substitution Procedures.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field engineering.
- B. Closeout procedures.
- C. Project record documents.
- D. Maintenance service
- E. Warranties
- F. Progress Payments.
- G. Examination.
- H. Preparation.
- I. Execution.
- J. Cutting and patching.
- K. Protecting installed construction.
- L. Final cleaning.

1.2 FIELD ENGINEERING

- A. Engineer will locate and Contractor shall protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- B. Control datum for survey is established by Owner-provided survey indicated on Drawings.
- C. Prior to beginning Work, verify and establish floor elevations of existing facilities to ensure that new Work will meet existing elevations in smooth and level alignment except where specifically detailed or indicated otherwise.
- D. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- E. Field engineering services provided by Engineer includes: Establish elevations, lines, and levels using recognized engineering survey practices.
- F. Maintain complete and accurate log of control and survey Work as Work progresses.

- G. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- H. Promptly report to Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- I. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.

1.3 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed. Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.
- B. Provide submittals to Engineer that are required by governing or other authorities.\
- C. Provide Consent of Surety and all Final Waivers.

1.4 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.
- B. Remove sediment from storm sewers, and catch basins.
- C. Clean site; sweep paved areas, rake clean landscaped surfaces.
- D. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- E. Landscape areas as required in documents.
- F. Restore roads, driveways, parking areas, lawns, drainage, and other items disturbed during construction to original condition or as required by the documents.

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, product data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Store record documents separate from documents used for construction.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates used.

3. Changes made by Addenda and modifications.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
 2. Include locations of concealed elements of the Work.
 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 5. Identify and locate existing buried or concealed items encountered during Project.
 6. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 7. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 8. Field changes of dimension and detail.
 9. Details not on original Drawings.
- F. Submit marked-up paper copy documents to Engineer before Substantial Completion.

1.6 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in Specification Sections for 1 year from date of Substantial Completion.
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

1.7 WARRANTIES

- A. Execute and assemble documents from Sub-contractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble in three D size ring three ring binder with durable plastic cloth cover.
- C. Submit prior to final Application for Payment.
- D. Warranty all work for a period of one year from the date of the final progress payment.

1.8 PROGRESS PAYMENTS

- A. The Owner may request from the Contractor waivers for proof of payment to all sub-contractors and suppliers utilized on this project prior to issuing payments.

- B. The Owner may request from the Contractor a Sworn Statement listing all sub-contractors and suppliers, their involvement with the project, their subcontracted amount, amount paid to date, and balance due prior to issuing payment.
- C. Failure to provide this information may result in not receiving payments or payments not being issued in a timely manner.

1.9 CORRECTION PERIOD

- A. For the period of one year from the date of final payment, promptly correct work or replace materials that are found to be defective.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.
- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
 - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
 - 1. Refer questionable mounting heights choices to Engineer for final decision.
 - 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

END OF SECTION

SECTION 02 41 19.13

SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolishing designated building equipment and fixtures.
 - 2. Demolishing designated construction.
 - 3. Cutting and alterations for completion of the Work.
 - 4. Protecting items designated to remain.
 - 5. Removing demolished materials.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.
- C. Shop Drawings:
 - 1. Indicate demolition and removal sequence.
 - 2. Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.4 QUALITY ASSURANCE

- A. Conform to applicable building code for demolition work, dust control, products requiring electrical disconnection and re-connection.
- B. Conform to General Specifications for Lead-Based Paint Abatement.
- C. Conform to applicable building code for procedures when hazardous or contaminated materials are discovered.
- D. Obtain required permits from authorities having jurisdiction.
- E. Perform Work in accordance with Municipality standard.
- F. Maintain one copy of each document on site.

1.5 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Owner will conduct salvage operations before demolition begins to remove materials Owner chooses to retain.
- C. Contractor shall abate all lead-based paint in areas of demolition. See General Specification for Lead-Based Paint Abatement.

1.6 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.
- B. Schedule Work to coincide with new construction.
- C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation in adjoining spaces.
- D. Perform noisy, malodorous, dusty, work:
 - 1. Between hours of 7:00 A.M. and 5:00 P.M.
 - 2. On following days: M - F.
- E. Coordinate utility and building service interruptions with Owner.
 - 1. Do not disable or disrupt building fire or life safety systems without three days prior written notice to Owner.
 - 2. Schedule tie-ins to existing systems to minimize disruption.
 - 3. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

1.7 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent occupied building areas.
- B. Cease operations immediately if structure appears to be in danger and notify Architect/Owner. Do not resume operations until directed.

PART 2 - PRODUCTS

- 2.1 Not Used.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Notify affected utility companies before starting work and comply with their requirements.
- B. Mark location and termination of utilities.

- C. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the Owner, and existing improvements indicated to remain.
- D. Erect and maintain weatherproof closures for exterior openings.
- E. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.
- F. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.
- G. Provide appropriate temporary signage including signage for exit or building egress.
- H. Do not close or obstruct building egress path.
- I. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

3.2 SALVAGE REQUIREMENTS

- A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.
- B. Tag components and equipment Owner designates for salvage.
- C. Protect designated salvage items from demolition operations until items can be removed.
- D. Carefully remove building components and equipment indicated to be salvaged.
- E. Disassemble as required to permit removal from building.
- F. Package small and loose parts to avoid loss.
- G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
- H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
- I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Maintain protected egress from and access to adjacent existing buildings at all times.
- C. Do not close or obstruct roadways or sidewalks without permits.
- D. Cease operations immediately when structure appears to be in danger and notify Architect/Owner.

- E. Disconnect and remove designated utilities within demolition areas.
- F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.
- G. Demolish in orderly and careful manner. Protect existing improvements, supporting structural members.
- H. Carefully remove building components indicated to be reused.
 - 1. Disassemble components as required to permit removal.
 - 2. Package small and loose parts to avoid loss.
 - 3. Mark components and packaged parts to permit reinstallation.
 - 4. Store components, protected from construction operations, until reinstalled.
- I. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- K. Remove temporary Work.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in-place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Form accessories.
 - 4. Form stripping.
- B. Related Requirements:
 - 1. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel and required supports for cast-in-place concrete.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest & Paper Association:
 - 1. AF&PA - National Design Specification (NDS) for Wood Construction.
- C. American Society of Mechanical Engineers:
 - 1. ASME A17.1 - Safety Code for Elevators and Escalators.
- D. APA - The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard - Structural Plywood.
- E. ASTM International:
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- F. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard No. 17 Grading Rules for West Coast Lumber.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on void form materials and installation requirements.
- C. Shop Drawings:
 - 1. Indicate:
 - a. Formwork, shoring, and reshoring.
 - b. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - c. Means of leakage prevention for concrete exposed to view in finished construction.
 - d. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift, and height of drop during placement.
 - e. Vertical, horizontal, and special loads according to ACI 347, and camber diagrams when applicable.
 - f. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.
 - g. Procedure and schedule for removal of shores and installation and removal of reshores.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Delegated Design Submittals:
 - 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for formwork, shoring, and reshores.
 - 2. Indicate loads transferred to structure during process of concreting, shoring, and reshoring.
 - 3. Include structural calculations to support design.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:
 - 1. Coordinate following Subparagraph with requirements specified in QUALIFICATIONS Article.
 - 2. Submit qualifications for licensed professional.

1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 347, 301, and 318.
- B. For wood products furnished for Work of this Section, comply with AF&PA.

C. Perform Work according to Municipal, State, and Federal standards.

1.6 QUALIFICATIONS

A. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Michigan.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept void forms on Site in manufacturer's original packaging and inspect for damage.

C. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Design, engineer, and construct formwork, shoring, and bracing according to ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line, and dimension as indicated on Drawings.

2.2 WOOD FORM MATERIALS

A. Form Materials: At discretion of Contractor.

2.3 PREFABRICATED FORMS

A. Manufacturers:

1. Sonoco Products Co.
2. Substitutions: As specified in Section 01 60 00 - Product Requirements.

B. Preformed Steel Forms:

1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. FRP Forms: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

D. Pan:

1. Material: Steel.
2. Configuration: Size and profile as required.

E. Tubular Column:

1. Description: Round spirally wound laminated fiber.
2. Surface Treatment: Release agent, non-reusable.
3. Sizes: As indicated on Drawings.

F. Steel Forms:

1. Description: Sheet steel, suitably reinforced.
2. Design: For particular use as indicated on Drawings.

G. Form Liners: Smooth, durable, grainless, and non-staining hardboard unless otherwise indicated on Drawings.

H. Framing, Studding, and Bracing: Stud or No. 3 structural light-framing grade.

2.4 FORMWORK ACCESSORIES

A. Form Ties:

1. Type: Removable.
2. Material: Galvanized.
3. Length: Adjustable.
4. Furnish waterproofing washer.
5. Free of defects capable of leaving holes larger than 1 inch in concrete surface.

B. Spreaders:

1. Description: Standard, non-corrosive metal-form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face.
2. Wire ties, wood spreaders, or through bolts are not permitted.

C. Form Release Agent:

1. Description: Colorless mineral oil that will not stain concrete or absorb moisture [or impair natural bonding or color characteristics of coating intended for use on concrete].

D. Corners:

1. Type: Chamfer,.
2. Size: 3/4 by 3/4 inches.
3. Lengths: Maximum possible.

E. Dovetail Anchor Slot:

1. Material: Galvanized steel.
2. Thickness: 22 gage.
3. Filling: Foam.
4. Fasten slot to concrete formwork according to manufacturer instructions, and insert foam filler to prevent concrete from entering slot during pour.

F. Flashing Reglets:

1. Material: Galvanized steel.
2. Thickness: 22 gage.
3. Lengths: Maximum possible.
4. Furnish alignment splines for joints.
5. Filling: Foam.

6. Fasten flashing reglet to concrete formwork according to manufacturer instructions, and insert foam to prevent concrete from entering reglet during pour.
- G. Vapor Retarder:
 1. Description: Polyethylene sheet.
 2. Thickness: 8 mils.
- H. Bituminous Joint Filler: Comply with ASTM D1751.
- I. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.
- J. Waterstop:
 1. Description: Flexible strip of bentonite waterproofing compound in coil form for joints in concrete construction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify lines, levels, and centers before proceeding with formwork.
- C. Verify that dimensions agree with Shop Drawings.
- D. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Engineer before proceeding.

3.2 INSTALLATION

- A. Earth Forms: Not permitted.
- B. Formwork:
 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
 4. Positioning:
 - a. Carefully verify horizontal and vertical positions of forms.
 - b. Correct misaligned or misplaced forms before placing concrete.
 5. Complete wedging and bracing before placing concrete.
 6. Erect formwork, shoring, and bracing to achieve design requirements according to ACI 318.
 7. Stripping:
 - a. Arrange and assemble formwork to permit dismantling and stripping.

- b. Do not damage concrete during stripping.
 - c. Permit removal of remaining principal shores.
8. Obtain approval of Engineer before framing openings in structural members not indicated on Drawings.
 9. Install fillet and chamfer strips on external corners of beams, joists, and columns.
 10. Install void forms according to manufacturer instructions.
 11. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view.
 12. Do not patch formwork.
 13. Leave forms in place for minimum number of days according to ACI 347.
- C. Form Removal:
1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, and removal has been approved by Engineer.
 2. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
 3. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
 4. Discard damaged forms.
 5. Form Release Agent:
 - a. Apply according to manufacturer instructions.
 - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
 - c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
 - d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
 6. Form Cleaning:
 - a. Clean forms as erection proceeds to remove foreign matter within forms.
 - b. Clean formed cavities of debris prior to placing concrete.
 - c. Flush with water or use compressed air to remove remaining foreign matter.
 - d. Ensure that water and debris drain to exterior through cleanout ports.
 - e. Cold Weather:
 - 1) During cold weather, remove ice and snow from within forms.
 - 2) Do not use de-icing salts.
 - 3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.
 7. Reuse and Coating of Forms:
 - a. Thoroughly clean forms and reapply form coating before each reuse.
 - b. For exposed Work, do not reuse forms with damaged faces or edges.
 - c. Apply form coating to forms according to manufacturer instructions.
 - d. Do not coat forms for concrete indicated to receive "scored finish."
 - e. Apply form coatings before placing reinforcing steel.
- D. Forms for Smooth Finish Concrete:
1. Use steel, plywood, or lined-board forms.
 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.

3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 4. Use full-sized sheets of form liners and plywood wherever possible.
 5. Tape joints to prevent protrusions in concrete.
 6. Apply forming and strip wood forms in a manner to protect corners and edges.
 7. Level and continue horizontal joints.
 8. Keep wood forms wet until stripped.
- E. Architectural Form Liners:
1. Erect architectural side of formwork first.
 2. Attach form liner to forms before installing form ties.
 3. Install form liners square, with joints and pattern aligned.
 4. Seal form liner joints to prevent grout leaks.
 5. Dress joints and edges to match form liner pattern and texture.
- F. Forms for Surfaces to Receive Membrane Waterproofing:
1. Use plywood or steel forms.
 2. After erection of forms, tape form joints to prevent protrusions in concrete.
- G. Framing, Studding, and Bracing:
1. Maximum Spacing of Studs:
 - a. Boards: Maximum 16 inches o.c.
 - b. Plywood: 12 inches o.c.
 2. Size framing, bracing, centering, and supporting members for sufficient strength to maintain shape and position under imposed loads from construction operations.
 3. Construct beam soffits of material minimum 2 inches thick.
 4. Distribute bracing loads over base area on which bracing is erected.
 5. When placed on ground, protect against undermining, settlement, and accidental impact.
- H. Form Anchors and Hangers:
1. Do not use anchors and hangers leaving exposed metal at concrete surface.
 2. Symmetrically arrange hangers supporting forms from structural-steel members to minimize twisting or rotation of member.
 3. Penetration of structural-steel members is not permitted.
- I. Inserts, Embedded Parts, and Openings:
1. Install formed openings for items to be embedded in or passing through concrete Work.
 2. Locate and set in place items required to be cast directly into concrete.
 3. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.
 4. Joints:
 - a. Install waterstops continuous without displacing reinforcement.
 5. Openings:
 - a. Provide temporary ports or openings in formwork as required to facilitate cleaning and inspection.
 - b. Locate openings at bottom of forms to allow flushing water to drain.
 6. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.

- J. Form Ties:
1. Provide sufficient strength and quantity to prevent spreading of forms.
 2. Place ties at least 1 inch away from finished surface of concrete.
 3. Leave inner rods in concrete when forms are stripped.
 4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.
- K. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- L. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 3. Appearance:
 - a. Show no overlapping of construction joints.
 - b. Construct joints to present same appearance as butted plywood joints.
 4. Arrange joints in continuous line straight, true, and sharp.
- M. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
 2. Do not embed wood or uncoated aluminum in concrete.
 3. Obtain installation and setting information for embedded items furnished under other Sections.
 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.
- N. Openings for Items Passing through Concrete:
1. Frame openings in concrete where indicated on Drawings.
 2. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
 3. Coordinate Work to avoid cutting and patching of concrete after placement.
 4. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- O. Screeds:
1. Set screeds and establish levels for tops of and finish on concrete slabs.
 2. Slope slabs to drain where required or as indicated on Drawings.
 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms; remove freestanding water.
- P. Screenshot Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
 2. Staking through membrane is not permitted.

Q. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed.
3. Remove chips, sawdust, and other debris.
4. Thoroughly blow out forms with compressed air just before concrete is placed.

3.3 TOLERANCES

- A. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances according to ACI 117.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection:
1. Inspect erected formwork, shoring, and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
 2. Notify Engineer after placement of reinforcing steel in forms but prior to placing concrete.
 3. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bars.
 - 2. Welded wire fabric.
 - 3. Reinforcement accessories.

- B. Related Requirements:
 - 1. Section 03 10 00 – Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
 - 3. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
 - 4. ACI SP-66 - ACI Detailing Manual.

- B. American Welding Society:
 - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

- C. ASTM International:
 - 1. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 3. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
 - 4. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 5. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 6. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - 7. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - 8. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
 - 9. ASTM A996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

10. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

D. Concrete Reinforcing Steel Institute:

1. CRSI 10-MSP - Manual of Standard Practice.
2. CRSI 10PLACE - Placing Reinforcing Bars.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with placement of formwork, formed openings, and other Work.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Indicate bar sizes, spacings, locations, splice locations, and quantities of reinforcing steel.
2. Indicate bending and cutting schedules.
3. Indicate supporting and spacing devices.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Submit certified copies of mill test report of reinforcement materials analysis.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statement:

1. Welders: Qualify procedures and personnel according to AWS D1.1.

1.5 QUALITY ASSURANCE

A. Perform Work according to ACI 301 ACI 318.

B. Prepare Shop Drawings according to ACI SP-66.

C. Perform Work according to Municipal, State, and Federal standards.

1.6 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months for employed weld types.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel:
 - 1. Comply with ASTM A615.
 - 2. Yield Strength: 60 ksi.
 - 3. Billet Bars: Deformed.
 - 4. Finish: Uncoated.

2.2 FABRICATION

- A. Fabricate concrete reinforcement according to ACI 318.
- B. Form standard hooks for, 90-degree bends, stirrups and tie hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters according to ACI 318.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form ties and stirrups from following:
 - 1. Bars No. 10 and Smaller: No. 3 deformed bars.
 - 2. Bars No. 11 and Larger: No. 4 deformed bars.
- F. Splicing:
 - 1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.
 - 2. Obtain approval of splice locations from Engineer.

2.3 ACCESSORY MATERIALS

- A. Tie Wire:
 - 1. Minimum 16 gage, annealed type.
- B. Chairs, Bolsters, Bar Supports, and Spacers:
- C. Size and Shape: To strengthen and support reinforcement during concrete placement conditions.
- D. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

2.4 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.
- B. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- C. Certificate of Compliance:
 - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Place, support, and secure reinforcement against displacement.
- B. Do not deviate from required position beyond specified tolerance.
- C. Do not weld crossing reinforcement bars for assembly except as permitted by Engineer.
- D. Do not displace or damage vapor retarder.
- E. Accommodate placement of formed openings.
- F. Spacing:
 - 1. Space reinforcement bars with minimum clear spacing according to ACI 318.
 - 2. If bars are indicated in multiple layers, place upper bars directly above lower bars.
- G. Maintain minimum concrete cover around reinforcement according to ACI 318 or as shown on the plans.

3.2 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Install reinforcement within following tolerances for flexural members, walls, and compression members:

1. Reinforcement Depth Greater Than 8 Inches:
 - a. Depth Tolerance: Plus or Minus 3/8 inch
 - b. Minus 3/8 inch
2. Reinforcement Depth Less Than or Equal to 8 Inches:
 - a. Depth Tolerance: Plus or Minus 1/2 inch
 - b. Minus 1/2 inch

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Perform field inspection and testing according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed inspection and testing firm.
- D. Reinforcement Inspection:
 1. Placement Acceptance: Inspect specified and ACI 318 material requirements and specified placement tolerances.
 2. Welding: Inspect welds according to AWS D1.1.
 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
 4. Weldability Inspection: Inspect for reinforcement weldability if formed from steel other than ASTM A706.
 5. Continuous Weld Inspection: Inspect reinforcement according to ACI 318.
 6. Periodic Weld Inspection: Inspect other welded connections.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes Cast-in-Place Concrete for Following Items:

1. Foundation walls.
2. Footings.
3. Supported slabs.
4. Slabs on grade.
5. Sidewalks.

B. Related Requirements:

1. Section 03 10 00 - Concrete Forming and Accessories.
2. Section 03 20 00 - Concrete Reinforcing.
3. Section 03 39 00 - Concrete Curing.
4. Section 31 23 23 - Fill.

1.2 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305R - Guide to Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
14. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
17. ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
20. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
31. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
33. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on joint devices, attachment accessories, admixtures, and mix design.

- C. Design Data:
 - 1. Submit concrete mix design for each concrete strength.
 - 2. Submit separate mix designs if admixtures are required for following:
 - a. Hot and cold weather concrete Work.
 - b. Air entrained concrete Work.
 - 3. Identify mix ingredients and proportions, including admixtures.
 - 4. Identify chloride content of admixtures and whether or not chlorides were added during manufacture.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit installation procedures and interfacing required with adjacent Work.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 301.
- B. Comply with ACI 305R when pouring concrete during hot weather.
- C. Comply with ACI 306.1 when pouring concrete during cold weather.
- D. Acquire cement and aggregate from one source for Work.
- E. Perform Work according to Municipal, State, and Federal standards.

1.7 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum seven days.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, water method.

2.2 MATERIALS

A. Concrete:

- 1. Cement:
 - a. Comply with ASTM C150, Type IIA - Air Entraining.
 - b. Type: Portland.
- 2. Normal Weight Aggregates:
 - a. Comply with ASTM C33.
 - b. Coarse Aggregate Maximum Size: According to ACI 301.
- 3. Water:
 - a. Comply with ACI 318.
 - b. Potable, without deleterious amounts of chloride ions.

B. Admixtures:

- 1. Air Entrainment: Comply with ASTM C260.
- 2. Chemical:
 - a. Comply with ASTM C494.
 - b. Type A - Water Reducing.
 - c. Type B - Retarding.
 - d. Type C - Accelerating.
 - e. Type D - Water Reducing and Retarding.
 - f. Type E - Water Reducing and Accelerating.
 - g. Type F - Water Reducing, High Range.
 - h. Type G - Water Reducing, High Range, and Retarding.
- 3. Fly Ash: Comply with ASTM C618, Class F or C.
- 4. Silica Fume: Comply with ASTM C1240.
- 5. Slag:
 - a. Description: Ground-granulated blast-furnace slag.
 - b. Comply with ASTM C989.
 - c. Grade 100 or 120.
- 6. Plasticizing:
 - a. Comply with ASTM C1017.
 - b. Type II, plasticizing and retarding.

2.3 CONCRETE MIX

- A. Select proportions for normal weight concrete according to ACI 301, Method 1.
- B. Concrete mixtures, general

1. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both.
 2. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - a. Fly Ash: 25%
 - b. Ground Granulated Blast-Furnace Slag: 50%
 - c. Combined Fly Ash and Ground Granulated Blast-Furnace Slag: 50%
 - d. Portland cement minimum, with fly ash not exceeding 25%
 3. Limit water-soluble, chloride-ion content in hardened concrete to 0.15% by weight of cement.
 4. Admixtures: Use admixtures according to manufacturer's written instructions.
 - a. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - c. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - d. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having a total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
 - 1) Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure: 5.0 percent.
 - 2) Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent.
- C. Concrete mixtures for building elements:
1. Class A – Structural Concrete:
 - a. Minimum Compressive Strength: 3000 psi at 7 days.
 - b. Minimum Compressive Strength: 4000 psi at 28 days.
 - c. Slump Limit: 4-1 inches.
 2. Class B – Mud Mat Concrete or Slab On Fill Concrete:
 - a. Minimum Compressive Strength: 3000 psi at 7 days.
 - b. Minimum Compressive Strength: 4000 psi at 28 days.
 - c. Slump Limit: 4-1 inches.
 3. Class C – Fill or Superstructure Concrete
 - a. Minimum Compressive Strength: 3000 psi at 7 days.
 - b. Minimum Compressive Strength: 4000 psi at 28 days.
 - c. Slump: 4-1 inches.
- D. Admixtures:
1. Include admixture types and quantities indicated in concrete mix designs only if approved by Engineer.
 2. Cold Weather:
 - a. Use accelerating admixtures in cold weather.
 - b. Use of admixtures will not relax cold-weather placement requirements.

3. Hot Weather: Use set-retarding admixtures.
4. Use calcium chloride only if approved by Engineer.
5. Add air entrainment admixture to concrete mix for Work exposed to freezing and thawing or deicing chemicals.
6. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fumes, and slag content as required.

E. Average Compressive Strength Reduction: Not permitted.

F. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C685.

G. Site-Mixed Concrete: Mix concrete according to ACI 318.

2.4 ACCESSORIES

A. Bonding Agent:

1. Description: Two-component modified epoxy resin.

B. Non-shrink Grout:

1. Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.
2. Comply with ASTM C1107.
3. Minimum Compressive Strength: 2,400 psi.

C. Bentonite Waterstops: Continuous 1 inch x $\frac{3}{4}$ inch strips, containing 75% bentonite by weight. Proper care and construction procedures shall be used to avoid damaging or displacing the strip while placing concrete. If the material exhibits considerable swelling prior to confinement in the joint, it must be replaced as directed by the Engineer. Joint shall be cleaned from debris and dry prior to replacement. Install per manufacturer's instructions as approved by the Engineer.

D. Wall Sleeves: HDPE thermoplastic sleeves, "CS" model, used for non-concrete pipe penetrations requiring "Link-seals".

E. Expansion Joints: ANSI/ASTM D1751, fiber type; 1/4 inch to 1 inch thick.

F. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

G. Corners: Chamfered, wood strip type 3/4" x 3/4" size.

H. Vapor Retarder: Clear polyethylene film, 6 mils thick, with joint tape. Joint tape as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Previously Placed Concrete:
 - 1. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
 - 2. Remove laitance, coatings, and unsound materials.
- C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- D. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- E. Remove water from areas receiving concrete before concrete is placed.

3.3 INSTALLATION

- A. Placing Concrete:
 - 1. Place concrete according to ACI 301.
 - 2. Notify testing laboratory and Engineer minimum 48 hours prior to commencement of operations.
 - 3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, and existing utilities are not disturbed during concrete placement.
 - 4. Install vapor retarder under interior slabs on grade according to ASTM E1643.
 - 5. Lap joints minimum 6 inches and seal watertight by taping edges and ends.
 - 6. Repairs:
 - a. Repair vapor retarder damaged during placement of concrete reinforcement.
 - b. Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.
 - 7. Joint Filler:
 - a. Separate slabs on grade from vertical surfaces with joint filler.

- b. Place joint filler in floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
 - c. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
8. Joint Devices:
- a. Coordination: Install construction joint devices in coordination with floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
 - b. Install joint device anchors, maintaining correct position to allow joint cover to be flush with floor and wall finish.
 - c. Install joint covers in longest practical length when adjacent construction activity is complete.
9. Deposit concrete at final position, preventing segregation of mix.
10. Place concrete in continuous operation for each panel or section as determined by predetermined joints.
11. Consolidate concrete.
12. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
13. Place concrete continuously between predetermined expansion, control, and construction joints.
14. Do not interrupt successive placement and do not permit cold joints to occur.
15. Place floor slabs in indicated checkerboard or saw-cut pattern.
16. Saw-Cut Joints:
- a. Saw-cut joints within 12 hours after placing.
 - b. Use 3/16 inch thick blade.
 - c. Cut into 1/4 depth of slab thickness.
17. Screeding:
- a. Screed floors and slabs on grade level.
 - b. Surface Flatness: maximum 1/4 inch in 10 feet.
- B. Separate Floor Toppings:
- 1. Prior to placing floor topping, remove deleterious material, roughen substrate concrete surface, and broom and vacuum clean.
 - 2. Place required dividers and reinforcement and other items to be cast in concrete.
 - 3. Apply bonding agent to substrate.
- C. Concrete Finishing:
- 1. Provide formed concrete surfaces to be left exposed with smooth finish.
- D. Curing and Protection:

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
2. Protect concrete footings from freezing for minimum of five days.
3. Maintain concrete with minimal moisture loss at relatively constant temperature for period as necessary for hydration of cement and hardening of concrete.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection and Testing: Performed by Owner's testing laboratory according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- F. Strength Test Samples:
 1. Sampling Procedures: Comply with ASTM C172.
 2. Cylinder Molding and Curing Procedures:
 - a. Comply with ASTM C31.
 - b. Cylinder Specimens: Field cured.
 3. Sample concrete and make one set of three cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
 4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
 5. Make one additional cylinder during cold weather concreting and field cure.
- G. Field Testing:
 1. Slump Test Method: Comply with ASTM C143.
 2. Air Content Test Method: Comply with ASTM C173.
 3. Temperature Test Method: Comply with ASTM C1064.
 4. Compressive Strength Concrete:
 - a. Measure slump and temperature for each sample.
 - b. Measure air content in air-entrained concrete for each sample.
- H. Cylinder Compressive Strength Testing:

1. Test Method: Comply with ASTM C39.
2. Test Acceptance: According to ACI 318.
3. Test one cylinder at seven days.
4. Test one cylinder at 28 days.
5. Retain one cylinder for 30 days for testing when requested by Engineer.
6. Dispose of remaining cylinders if testing is not required.

I. Core Compressive Strength Testing:

1. Sampling and Testing Procedures: Comply with ASTM C42.
2. Test Acceptance: According to ACI 318.
3. Drill three cores for each failed strength test from failed concrete.

J. Patching:

1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
2. Honeycombing or Embedded Debris in Concrete:
 - a. Not acceptable.
 - b. Notify Engineer upon discovery.
3. Patch imperfections according to ACI 301.

K. Defective Concrete:

1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
2. Repair or replacement of defective concrete will be determined by Engineer.
3. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Initial and final curing of horizontal concrete surfaces.

1.2 RELATED SECTIONS

- A. Section 033000 – Cast-In-Place Concrete.

1.3 REFERENCES

- A. ACI 301 – Structural Concrete for Buildings.
- B. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.
- C. ACI 308 - Standard Practice for Curing Concrete.
- D. ASTM C171 - Sheet Materials for Curing Concrete.
- E. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Product Data: Provide data on curing compounds, product characteristics, compatibility and limitations.
- C. Manufacturer's Installation Instructions: Indicate criteria for preparation and application.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and 308.
- B. Maintain one copy of document on site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Section 016000.
- B. Deliver curing materials in manufacturer's packaging including application instructions.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Liquid Membrane Forming Curing Compound ASTM C309 Type 1 Class B, liquid acrylate type, clear, without fugitive dye; curing compounds shall not contain ingredients which might stain through, injure the concrete or prevent a good bond for subsequent coatings or finishes; manufactured by Sonneborn Building Products or equal.
- B. Absorptive Mats ASTM C171, cotton fabric or burlap-polyethylene, minimum 8 oz/sq yd. bonded to prevent separation during handling and placing.
- C. Water: Potable and not detrimental to concrete.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 017000 – Execution and closeout requirements for application examination.
- B. Verify that substrate surfaces are ready to be cured.

3.2 EXECUTION - HORIZONTAL SURFACES

- A. Cure slabs in accordance with ACI 308.
- B. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
- C. Membrane Curing Compound: Apply curing compound in accordance with manufacturer's instructions.

3.3 EXECUTION - VERTICAL SURFACES

- A. Cure surfaces in accordance with ACI 308.
- B. Spraying: Spray water over surfaces and maintain wet for 7 days.
- C. Membrane Curing Compound: Apply curing compound in accordance with manufacturer's instructions.

3.4 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 015000.

END OF SECTION

SECTION 04 05 00

MASONRY MORTARING AND GROUTING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mortar and grout for masonry.

1.2 RELATED WORK

- A. Section 042000 - Unit Masonry.
- B. Section 042313 - Glass Unit Masonry.

1.3 REFERENCES

- A. ASTM C91 - Masonry Cement.
- B. ASTM C144 - Aggregate for Masonry Mortar.
- C. ASTM C150 - Portland Cement.
- D. ASTM C207 - Hydrated Lime for Masonry Purposes.
- E. ASTM C270 - Mortar for Unit Masonry.
- F. ASTM C387 - Packaged, Dry, Combined Materials, for Mortar and Concrete.
- G. ASTM C404 - Aggregates for Masonry Grout.
- H. ASTM C476 - Grout for Masonry.
- I. ASTM C1019 - Method of Sampling and Testing Grout.
- J. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.4 SUBMITTALS

- A. Include design mix, indicate Proportion or Property Method used, required environmental conditions, and admixture limitations.
- B. Submit test reports on grout indicating conformance to ASTM C476.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect per manufacturer's recommendations.

- B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperatures to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.

1.7 MIX TESTS

- A. Test mortar and grout.
- B. Testing of Mortar Mix: In accordance with ASTM C780.
- C. Test mortar mix for compressive strength 1800 psi.
- D. Testing of Grout Mix: In accordance with ASTM C1019.

2. PART 2 PRODUCTS

2.1 MORTAR

- A. Exterior colored block - matching colored mortar.
- B. Interior block - S mortar standard color block.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type II, Gray, color.
- B. Masonry Cement: ASTM C91, Type S.
- C. Mortar Aggregate: ASTM C144, standard masonry type.
- D. Grout Aggregate: ASTM C404.

2.3 GROUT FINE AGGREGATE: Masons sand; 70 percent by volume.

- A. Water: Clean and potable.
- B. Bonding Agent: Portland Cement and 1/10 lime.

2.4 MORTAR COLOR

- A. Exterior Mortar Color: Color by Owner.
- B. Interior Mortar Color: Standard block color.

2.5 ADMIXTURES

- A. Plasticizer: Water reducing type which reduces porosity and absorption to increase bond strength; grout manufacturer's standard.
- B. Water Repellent: Liquid type; Rheopel manufactured by Master Builders Inc., or equal.

2.6 MORTAR MIXES

- A. Mortar for Load Bearing Walls and Partitions: ASTM C270, Type S using the Property Method.
- B. Mortar: ASTM C270, Type S using the Property Method.

2.7 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- B. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, retemper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures of 80 degrees F (26 degrees C), or two-and-one-half hours at temperatures under 50 degrees F (10 degrees C).

2.8 GROUT MIXES

- A. Engineered Masonry: 3000 psi strength at 28 days; 7-8 inches slump; mixed in accordance with ASTM C476 Fine grout.

2.9 GROUT MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476 Fine grout.
- B. Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Request inspection of spaces to be grouted.

3.2 PREPARATION

- A. Apply bonding agent to existing surfaces.
- B. Plug cleanout holes with block masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.3 INSTALLATION

- A. Install mortar and grout in accordance with manufacturer's instructions.
- B. Do not displace reinforcement while placing grout.
- C. Remove excess mortar. END OF SECTION

SECTION 04 20 00

UNIT MASONRY

1. 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. Concrete Unit Masonry.
 - 2. Accessories

1.3 RELATED SECTIONS

- A. Section 040500 – Mortar and Grout.
- B. Section 079000 – Joint Protection.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops the following installed compressive strengths (fm) at 28 days.
 - 1. For Concrete Unit Masonry: As follows, based on net area:
 - a. fm = 1500 psi (10.3 MPa).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not install until they are in an air-dried condition.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit masonry damaged by frost or freezing conditions. Comply with the following requirements:
 - 1. Cold-Weather Construction: When the ambient temperature is within the limits indicated, use the following procedures:
 - a. 40 to 32 deg F (4 to 0 deg C): Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C).
 - b. 32 to 25 deg F (0 to -4 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry.
 - c. 25 to 20 deg F (-4 to -7 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C) if grouting. Use heat on both sides of walls under construction.
 - d. 20 deg F (-7 deg C) and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C). Provide enclosures and use heat on both sides of walls under construction to maintain temperatures above 32 deg F (0 deg C) within the enclosures.
 - 2. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
 - a. 40 to 25 deg F (4 to -4 deg C): Cover masonry with a weather-resistant membrane for 48 hours after construction.
 - b. 25 to 20 deg F (-4 to -7 deg C): Cover masonry with insulating blankets or provide enclosure and heat for 48 hours after construction to prevent freezing. Install wind breaks when wind velocity exceeds 15 mi./h (25 km/h).
 - c. 20 deg F (-7 deg C) and Below: Provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after construction.

3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried out, but not less than 7 days after completion of cleaning.
- D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and above.

2. PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Standard Concrete Masonry Units: ASTM C 90 and as follows:
1. Furnish and install concrete masonry units (C.M.U.) per ACI 530 with horizontal ties and mortar or grout filled cavity where indicated.
 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength indicated below:
 - a. 1900 psi (13.1 MPa).
 - b. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.
 3. Normal weight units shall be used at concealed and underground conditions.
 4. Light-weight units shall be used at conditions exposed to view.
 5. Size: Nominal modular size of 8" wide x 16" long x 8" high.
 6. Special Units: Provide special units for 90 degree corners, bond beams, lintels, and bullnosed corners.
 7. Concrete Masonry Units:
 - a. Decorative CMU: Stacked Bond, Color by Owner. Basis of Design- Shouldice Smooth. Pre-finished, integrally colored concrete block meeting the requirements of ASTM C90-03. exterior faces are ground to expose the variegated colors of natural aggregate. Units shall be manufactured with an integral water repellent additive. Ten percent of block to be an accent color in a random pattern.
 - b. Regular Block: Running Bond, standard color.

2.2 REINFORCING STEEL

- A. Steel Reinforcing Bars: Material and grade as follows:
1. Billet steel complying with ASTM A 615 (ASTM A 615M).
 2. Epoxy-coated billet steel complying with ASTM A 615 (ASTM A 615M) and ASTM A 775 (ASTM A 775M).
 - a. Grade 60 (Grade 400).
- B. Deformed Reinforcing Wire: ASTM A 496, with ASTM A 153, Class B-2 zinc coating.

- C. Welded-Wire Fabric: ASTM A 185.
- D. Ladder style horizontal reinforcement shall be installed continuous at every second C.M.U. course.

2.3 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.
- B. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
 - 1. Headed bolts.
 - 2. Nonheaded bolts, straight.
 - 3. Nonheaded bolts, bent in manner indicated.

2.4 EMBEDDED FLASHING MATERIALS

- A. Asphalt-Coated Copper Flashing: Manufacturer's standard product consisting of sheet copper of weight indicated below, coated with flexible asphalt.
 - 1. Weight: 3 oz./sq. ft. (0.9 kg/sq. m).
 - 2. Weight: 5 oz./sq. ft. (1.5 kg/sq. m).
 - 3. Weight: 7 oz./sq. ft. (2 kg/sq. m).
 - 4. Application: Use where flashing is fully concealed in masonry.
- B. Solder and Sealants for Sheet-Metal Flashings: As specified in Division 7 Section "Flashing and Sheet Metal."
- C. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.
- D. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
- E. Products: Subject to compliance with requirements, provide one of the following:

2.5 ACCESSORIES

- A. Preformed Control Joints (rubber): Provide with corner and tee accessories, cement fused joints.
- B. Joint Filler: Closed cell polyurethane; oversized 50 percent to joint width; self-expanding.
- C. Building Paper: 15# asphalt saturated felt.
- D. Weep Holes: 1" open head joints spaced not greater than 48" on center.

2.6 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.
 - 1. For masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface-acting acids, chelating, and wetting agents.
 - 2. For dark-colored masonry not subject to metallic oxidation stains, use formulation consisting of a liquid blend of surface-acting acids and special inhibitors.
 - 3. For masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic and inorganic acids and special inhibitors.
 - 4. Available Products: Subject to compliance with requirements, products that may be used to clean unit masonry surfaces include, but are not limited to, the following:
 - 5. Products: Subject to compliance with requirements, provide one of the following:
 - a. 202 New Masonry Detergent; Diedrich Technologies, Inc.
 - b. 200 Lime Solv; Diedrich Technologies, Inc.
 - c. 202V Vana-Stop; Diedrich Technologies, Inc.
 - d. Sure Klean No. 600 Detergent; ProSoCo, Inc.
 - e. Sure Klean No. 101 Lime Solvent; ProSoCo., Inc.
 - f. Sure Klean Vana Trol; ProSoCo, Inc.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completion of masonry. After installing equipment, complete masonry to match construction immediately adjacent to the opening.
- B. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arrises, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), nor 3/8 inch in 20 feet (10 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For vertical alignment of head joints, do not exceed plus or minus 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) 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 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For top surface of bearing walls, do not exceed 1/8 inch (3 mm) in 10 feet (3 m), nor 1/16 inch (1.5 mm) within width of a single unit.
- C. Variation in Mortar-Joint Thickness: Do not vary from bed-joint thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary bed-joint thickness from bed-joint thickness of adjacent course by more than 1/8 inch (3 mm). Do not vary from head-joint thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary head-joint thickness from adjacent head-joint thickness by more than 1/8 inch (3 mm). Do not vary from collar-joint thickness indicated by more than minus 1/4 inch (6 mm) or plus 3/8 inch (10 mm).

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.

- B. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

END OF SECTION

SECTION 05 50 00

MISCELLANEOUS METALS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers furnishing and installing all items of miscellaneous metal, as shown on drawings, as herein specified and/or as required for a complete job.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Lintels & Miscellaneous Structural Steel: All steel shall conform to "Structural Steel, ASTM A36 Specifications: latest edition.
- B. All members shall be shop painted one (1) shop coat of gray oil primer and spot primed over welds and scratches as required.
- C. Refer to drawings for steel lintel sizes.

3. PART 3 EXECUTION

3.1 INSTALLATION

- A. Steel Lintels & Miscellaneous Structural Steel: Fabrication for all Structural Steel shall be in accordance with the latest edition, including any addendum of the AISC Specification, entitled "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".

3.2 ERECTION

- A. Erection shall be in accordance with manufacturer's recommendations and the latest AISC Specifications for Fabrication and Erection of Structural Steel for Buildings.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

1. 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. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Wood furring, grounds, nailers, and blocking.
 - 4. Sheathing.
 - 5. Utility shelving.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 6 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.
- B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
 - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

2. PART 2 PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association.
 - 2. NLGA - National Lumber Grades Authority (Canadian).
 - 3. RIS - Redwood Inspection Service.
 - 4. SPIB - Southern Pine Inspection Bureau.
 - 5. WCLIB - West Coast Lumber Inspection Bureau.
 - 6. WWPA - Western Wood Products Association.

- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
 - 1. 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 inspection agency.

2.2 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.

- B. Framing Other than Non-Load-Bearing Partitions: Provide framing of the following grade and species:
 - 1. Grade: No. 2 or better.
 - 2. Species and Grade: Any species of machine stress-rated (MSR) dimension lumber with a grade of 1800f-1.6E.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.4 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that evidence compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Laminated-Veneer Lumber: Lumber manufactured by laminating wood veneers in a continuous press using an exterior-type adhesive complying with ASTM D 2559 to produce members with grain of veneers parallel to their lengths and complying with the following requirements:
1. Extreme Fiber Stress in Bending: 2500 psi (17 MPa) for 12-inch nominal- (286-mm actual-) depth members.
 2. Modulus of Elasticity: 2,000,000 psi (13 800 MPa).
 3. Tension Parallel to Grain: 1850 psi (13 MPa).
 4. Compression Parallel to Grain: 2800 psi (19 MPa).
 5. Compression Perpendicular to Grain: 400 psi (3 MPa) perpendicular to and 500 psi (3.5 MPa) and parallel to glue line.
 6. Horizontal Shear: 285 psi (2 MPa) perpendicular to and 190 psi (1.3 MPa) parallel to glue line.
- C. Parallel-Strand Lumber: Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with ASTM D 2559, and cured under pressure to produce members with grain of strands parallel to their lengths and complying with the following requirements:
1. Extreme Fiber Stress in Bending: 2900 psi (20 MPa) for 12-inch nominal- (286-mm actual-) depth members.
 2. Modulus of Elasticity: 2,000,000 psi (13 800 MPa).
 3. Tension Parallel to Grain: 2400 psi (16.5 MPa).
 4. Compression Parallel to Grain: 2900 psi (20 MPa).
 5. Compression Perpendicular to Grain: 400 psi (3 MPa) perpendicular to and 600 psi (4.1 MPa) and parallel to wide face of strands.
 6. Horizontal Shear: 210 psi (1.4 MPa) perpendicular to and 290 psi (2 MPa) and parallel to wide face of strands.

2.5 AIR-INFILTRATION BARRIER

- A. Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
- B. Air retarder complying with ASTM E 1677; made from polyolefins; either cross-laminated films, woven strands, or spunbonded fibers; coated or uncoated; with or without perforations to transmit water vapor but not liquid water; and as follows:
1. Minimum Thickness: 3 mils (0.08 mm).
 2. Minimum Water-Vapor Transmission: 10 perms (575 ng/Pa x s x sq. m) when tested according to ASTM E 96, Procedure A.
 3. Maximum Flame Spread: 25 per ASTM E 84.
 4. Minimum Allowable Exposure Time: 3 months.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacturer.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.
 - 2. Where rough carpentry is fastened to concrete use Hilti Titen Screws or equal.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

3. PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with AWWA M4 to cut surfaces of preservative-treated lumber and plywood.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. "Recommended Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction."
 - 4. "Table 23-I-Q--Nailing Schedule" of the Uniform Building Code.
 - 5. "Table 2305.2--Fastening Schedule" of the BOCA National Building Code.
 - 6. "Table 1705.1--Fastening Schedule," of the Standard Building Code.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish

work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

- G. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
- H. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Install permanent grounds of dressed, preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Install framing members of size and at spacing indicated.
- D. Do not splice structural members between supports.
- E. Firestop concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where firestopping is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal- (38-mm actual-) thickness lumber of same width as framing members.

END OF SECTION

SECTION 06 11 00

WOOD FRAMING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural framing.

1.2 REFERENCES

- A. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.
- B. AWWPA (American Wood Preservers Association) C1 - All Timber Products Preservative Treatment by Pressure Process.
- C. NFPA: National Forest Products Association.
- D. SPIB: Southern Pine Inspection Bureau.
- E. WCLIB: West Coast Lumber Inspection Bureau.
- F. WWPA: Western Wood Products Association.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with the following agencies:
 - 1. Lumber Grading Agency: Certified by ALSC.
- B. In lieu of grade stamping exposed to view lumber and plywood, submit manufacturer's certificate products meet or exceed specified requirements.

2. PART 2 PRODUCTS

2.1 LUMBER MATERIALS

- A. Joist Framing: Stress Group D.

2.2 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fasteners: Hot-dipped galvanized steel.

3. PART 3 EXECUTION

3.1 FRAMING

- A. Set structural members level and plumb, in correct position.

- B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Place horizontal members flat, crown side up.
- D. Construct load bearing framing and curb members full length without splices.
- E. Spacing of fasteners as directed by Engineer.

3.2 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Brush apply two coats of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

3.3 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum, and 1/2 inch maximum in 30 feet.

END OF SECTION

SECTION 06 17 53

SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop-fabricated wood trusses for:
 - a. Roof framing.
 - b. Bridging, bracing, and anchorage.
2. Preservative treatment of wood.

B. Related Requirements:

Section 061000 - Rough Carpentry: Framing of openings between trusses, wood blocking, plating, support members, framing for openings, and framing of openings between trusses.

1.2 REFERENCE STANDARDS

A. American Wood Protection Association:

1. AWPA M4 - Standard for the Care of Preservative-Treated Wood Products.
2. AWPA U1 - Use Category System: User Specification for Treated Wood.

B. APA - The Engineered Wood Association:

1. APA/EWA Plywood Design Specification.

C. ASTM International:

1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
4. ASTM A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
5. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

6. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
8. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
9. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

D. Forest Stewardship Council:

1. FSC Guidelines.

E. National Particleboard Association:

1. NPA A208.1 - Particleboard.

F. Redwood Inspection Service:

1. RIS - Standard Specifications for Grades of California Redwood Lumber.

G. Southern Pine Inspection Bureau:

1. SPIB - Standard Grading Rules for Southern Pine Lumber.

H. Truss Plate Institute:

1. TPI - Building Component Safety Information (BCSI): Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.
2. TPI DSB - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses.
3. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction.

I. U.S. Department of Commerce - National Institute of Standards and Technology:

1. Voluntary Product Standard PS 1 - Structural Plywood.
2. Voluntary Product Standard PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
3. Voluntary Product Standard PS 20 - American Softwood Lumber Standard.

J. West Coast Lumber Inspection Bureau:

1. WCLIB Standard 17 - Grading Rules for West Coast Lumber.

K. Western Wood Products Association:

1. WWPA G-5 - Western Lumber Grading Rules.

1.3 COORDINATION

- A. Section 013000 - Administrative Requirements: Requirements for coordination.

- B. Coordinate placement of sheathing with Work of this Section.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit truss plate connections, bearing plates, anchor connections, wind uplift connections, bridging and bracing.
- C. Shop Drawings: Indicate truss sizes, dimensions, spacing of trusses, associated components, uplift connectors, web and chord sizes, plate sizes, fastener descriptions and spacings, loads and truss cambers, and framed openings.
- D. Design Calculations: Indicate design loads, truss reactions, and member forces, deflections, and stresses.
- E. Manufacturer's/Fabricator's Certificate: Certify that products meet or exceed specified requirements.
- F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for sizes, dimensions, spacing of trusses, associated components, uplift connectors, web and chord sizes, plate sizes, fastener descriptions and spacings, design loads, truss cambers, and framed openings.
- G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer/fabricator, erector, and licensed professional.
 - 2. Submit manufacturer's/fabricator's approval of erector.

1.5 QUALITY ASSURANCE

- A. Perform Work as follows:
 - 1. Lumber Grading: Certified by DOC PS 20.
 - 2. Plywood Grading Agency: Certified by APA/EWA.
 - 3. Lumber: Comply with DOC PS 20.
 - 4. Wood Structural Panels: DOC PS 1 or DOC PS 2.
- B. Truss Design, Fabrication, and Installation: Comply with TPI BSCI, TPI DSB, and TPI 1.
- C. Fire-Rated Roof Construction:
 - 1. Rating as indicated on Drawings.
 - 2. Tested Rating: Determined according to ASTM E119.
- D. Surface Burning Characteristics:

1. Fire-Retardant-Treated Materials: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- E. Apply label from agency approved by authority having jurisdiction to identify each preservative-treated and fire-retardant-treated material.
- F. Perform Work according to local standards.
- G. Maintain one copy of each standard affecting Work of this Section on Site.

1.6 QUALIFICATIONS

- A. Manufacturer/Fabricator: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer/fabricator.
- C. Licensed Professional: Professional engineer/architect experienced in design of specified Work and licensed in State of Michigan.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site and inspect for damage.
- C. Storage:
 1. Do not lay trusses flat.
 2. Store truss depth in vertical position resting on intermittent bearing pads.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
 1. Verify field measurements prior to fabrication.
 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design Roof Live and Dead Load: 60 psf, with deflection limited to $L/720$ of span including ceiling load.

2.2 MATERIALS

A. Manufacturing:

1. Trusses shall be manufactured to meet the quality requirements of the Standard and in accordance with the information provided in the final approved Truss Design Drawings.

B. Lumber Grading Rules: Comply with lumber inspection bureau or agency approved by the American Lumber Standards Committee, and shall be the size, species, and grade as shown on the Truss Design Drawings, or equivalent as approved by the Truss Design Engineer/Truss Designer.

C. Adjustment of value for duration of load or conditions of use shall be in accordance with NDS.

D. Metal Plate Connectors:

1. Comply with TPI 1, Section 6.
2. Thickness shall not be less than: 0.036 inch (20 gauge).
3. Die stamped with integral teeth.
4. Finish: Hot dip galvanized.

E. Truss Bridging: Type, size, and spacing as recommended by truss manufacturer/fabricator.

2.3 FABRICATION

A. Fabricate trusses to achieve specified structural requirements.

B. Frame special sized openings in web framing as indicated on Drawings.

2.4 WOOD TREATMENT

A. Fire Retardant Treatment (if applicable):

1. Chemically treated and pressure impregnated.
2. Flame Spread:
 - a. 25 or less when tested according to ASTM E84.
 - b. Showing no evidence of significant progressive combustion when test is continued for additional 20 minutes.

B. Wood Preservative by Pressure Treatment (if applicable):

1. Comply with AWWA U1:
 - a. Commodity Specification A - Sawn Products.
2. Type: ACQ.

C. Wood Preservative by Surface Application:

1. Color: Clear.

D. Moisture Content:

1. Kiln dried (KDAT).
2. Lumber: Maximum 19 percent after treatment.
3. Structural Panels: Maximum 15 percent after treatment.

2.5 ACCESSORIES

A. Wood Blocking, Plating, Support Members, Framing for Openings:

1. As specified in Section 061000 - Rough Carpentry.

B. Fasteners and Anchors:

1. Material:
 - a. High Humidity and Treated Wood Locations: ASTM A153 (A153M), hot dipped galvanized steel.
 - b. Elsewhere: Unfinished steel.
2. Nails and Staples: Comply with ASTM F1667.
3. Anchors Type (if applicable): Toggle bolt type for anchorage to hollow masonry, Expansion shield and lag bolt type for anchorage to solid masonry or concrete, Bolt or ballistic fastener for anchorages to steel.

C. Bearing Plates

1. Material:
 - a. Hot-dip galvanized steel.

2.6 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Inspection: Inspect Work performed at manufacturer's/fabricator's facility to verify conformance to Contract Documents.

C. Certificate of Compliance:

1. If manufacturer/fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's/fabricator's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer/fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for erection examination.
- B. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for erection preparation.
- B. Coordinate placement of bearing/support items.

3.3 ERECTION

- A. Set members level, plumb, and in correct position.
- B. Make provisions for erection loads and sufficient temporary bracing to maintain plumb and aligned structure until completion of erection and installation of permanent bracing.
- C. Do not field cut or alter structural members without approval of Architect/Engineer.
- D. Place headers and supports to frame openings.
- E. Frame openings between trusses with lumber as specified in Section 061000 - Rough Carpentry.
- F. After erection, touch up damaged surfaces with primer consistent with shop coat.
- G. Site-Applied Wood Treatment (if applicable):
 - 1. Brush-apply two coats of preservative treatment on wood in contact with cementitious materials, roofing and related metal flashings.
 - 2. Treat site-sawn cuts by applying preservative according to AWPA M4.
 - 3. Allow preservative to dry prior to erecting members.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Indicated Position:
 - 1. Framing Members: 1/2 inch (12 mm).

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

1. PART 1 GENERAL

1.1 SCOPE

- A. This section covers furnishing and installing all finish carpentry, millwork and trim as required for the work specified.
 - 1. Job Requirements: Unexposed portions of millwork items and trim shall be backprimed on the job with wood preservatives before installation. Backpriming shall be done by the Contractor.
- B. Lumber must be sound, thoroughly seasoned, well manufactured and free from warp that cannot be corrected in the process of bridging or nailing. Woodwork exposed in finished interior shall be dressed.
- C. Each piece or bundle of lumber shall be identified with the grade and trademark. Use only the recognized official marks of the Association under whose rules it is graded. Grade and trademark will not be required if each shipment is accompanied by Certificate of Inspection issued by Association.

1.2 MATERIALS

- A. Plastic Laminate Backing: APA B-D grade, Group 2, exposure 1, 3/4" thick.
- B. Sills: As specified by Owner.
- C. Plastic Laminates:
 - 1. All materials shall be in accordance with NEMA Specifications as manufactured by Formica Corp. or Owner approved equal. Colors and finishes shall be as selected by the Owner. Plastic laminate should be NEMA LD 3, Type PF42, 1.1 mm (0.042 inch) thickness.
 - 2. Countertops, backsplashes and drop edges shall be fully post formed cove and dripless edge type of high pressure plastic laminate fully adhered to 3/4" thick high-density particleboard backing. There shall be no seams or joints in the plastic laminate across the countertops, backsplashes or drop edges. Install moisture sealing phenolic impregnated Kraft core backer sheets under all countertop construction. The perimeter of all countertops and cutouts shall be sealed with a one-part silicone sealant.
 - 3. All plastic laminates shall be secured to backing in strict accordance with the written instructions of the manufacturer.
- D. Wood Interior Door/Window Casings: If used shall be as specified by Owner.
- E. Wood Base Trim: If used shall be as specified by Owner. Base shall match appearance of the face of wood casing.

1.3 WORKMANSHIP

- A. Interior Finish Carpentry: In general, and as far as practicable, finish and assemble all interior or wood finish at mill. Fabricate all materials in approved manner. All moldings shall be clearly cut and sharply defined and miters accurately made. Where nails and screws are necessary, they shall be concealed, cut off heads and plug where conditions require.
- B. Woodwork, counters, etc., throughout shall be cleaned free from tool marks with all nails set and holes sandpapered smooth.
- C. Install all frames and finish of every description plumb, level, straight and true with proper grounds and firmly secured to same. Fit and scribe all finish carpentry or other finished work in careful manner; do not injure surfaces. All nailing shall be blind-nailed wherever possible and so located and driven as not to be visible in finish. Refer to details.
- D. Application of Hardware: Receive, store and be responsible for all finish hardware. Properly tag, index and file all keys as directed. Apply hardware in accordance with manufacturer's instructions. Use care not to injure work when applying hardware.
- E. Cabinetry: This contractor shall be responsible for the installation of the cabinetry along with final hook-up for electrical devices and plumbing fixtures.

END OF SECTION

SECTION 06 41 00

CABINETS AND COUNTERTOPS

1. PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes plastic-laminate-faced cabinets and countertops.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 22400 Section "Plumbing Fixtures" for sink units mounted in countertops.

1.2 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each casework type specified.
- C. Product data for each hardware type specified.
- D. Shop drawings for casework showing location and size, accessories, materials, finishes, and filler panels. Include fully dimensioned plans, elevations, and anchorage details to countertop and walls.
- E. Shop drawings for countertops showing sizes, shapes, edge and backsplash profiles, cutouts for plumbing fixtures, and methods of joining.
- F. Samples for initial selection purposes of manufacturer's color charts in the form of unit sections showing the full range of colors, textures, and patterns available for each type of material indicated or exposed to view.

1.3 QUALITY ASSURANCE

- A. Cabinets: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
- B. Solid Surface Counter Tops & Sills: Comply with ISFA 2-01, NSF/ANSI 51 for concessions area
- C. Single-Source Responsibility: Obtain cabinet casework from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cabinets as factory-assembled units, packaged individually.

- B. Protect cabinets during storage and installation from dust, damage and vandalism with original packaging, tarps, padding or isolation as required.

1.5 PROJECT CONDITIONS

- A. Environmental Conditions: Comply with cabinet manufacturer's written requirements for temperature and humidity conditions during storage and installation. Do not install cabinets until these conditions have been attained and stabilized.
- B. Field Measurements: Verify casework dimensions by field measurements. Verify that cabinets can be installed in compliance with the original design and referenced standards.
- C. Field Measurements: Verify countertop size and shape prior to fabrication by field measurements taken after base units are installed.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in 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. Casework:
 - a. Locally shop fabricated
 - b. Regionally shop fabricated
 - 2. Solid Surface for countertops and sills, standard or least expensive color range:
 - a. Avonite
 - b. Corian
 - c. Formica Solid Surface
 - d. Wilsonart Solid Surfaces

2.2 CABINET MATERIALS, GENERAL

- A. Sizes, dimensions, and thicknesses given are minimum dimensions.
- B. Particleboard: ANSI A208.1, mat-formed particleboard, Grade 1-M-2 with minimum density of 40 pcf (640 kg/cu. m), internal bond of 60 psi (414 kPa), and minimum screw-holding capacity of 225 lbs. (1000 N) on faces and 200 lbs. (890 N) on edges.
- C. Hardwood Plywood: ANSI/HPMA HP hardwood and decorative plywood, Good Grade (1) or better.

- D. Particleboard Core Plywood: ANSI/HPMA HP hardwood and decorative plywood, Good Grade (1) or better.
- E. Solid Wood: Clear, dry, sound, and free of defects selected from First Grade lumber as defined by NHLA.
- F. Hardboard: ANSI A135.4, Class 1, tempered.
- G. Engineered Polymer Sheets (PVC): 4'x8' sheets, 3/4" thick conforming to ASTM D792, ASTM D570, ASTM D638, ASTM D790 standards. Mechanical fasteners complying with ASTM D1761.
- H. Plastic Laminate: NEMA LD 3.
 - 1. Provide color through plastic laminate.
- I. Hardware: Handles - 16mm wire pulls.
- J. Thermoset Decorative Panels: (where applicable) Comply with ALA-1988 and NEMA LD 3 for GP 20; melamine or polyester.

2.3 PLASTIC LAMINATE FACE CASEWORK

- A. Face Style: Flush.
- B. Face Frame: 1-by-1-5/8-inch (25-by-41-mm) solid wood frame rails and stiles with glued mortise and tenon joints.
- C. Concealed Surfaces: Sound and dry solid wood, plywood, or particleboard without defects affecting strength, utility, or stability.
- D. Sides, Dividers, Tops, Bottoms, Shelves, and Stretchers: Plastic laminate GP 28 on 1/2-inch- (12.7-mm-) thick particleboard. Provide stretchers for top of base cabinet.
- E. Back Panels: 1/8-inch- (3.2-mm-) thick hardboard with thermoset decorative panels on interior surfaces fastened to rear edge of end panels and to top and bottom rails.
- F. Exposed Edge Treatment: Edge doors and drawer fronts with plastic laminate of same material as exposed faces.
- G. Semi-Exposed Edge Treatment: Edge top of drawer body with high-impact plastic tee edging. Edge remaining casework surfaces with plastic laminate GP 28 matching adjoining plastic laminate in color, pattern, and finish.
- H. Doors, Drawer Fronts, Fixed Panels, Toeboards, and Ends: Plastic laminate GP 28 on 5/8-inch- (16-mm-) thick particleboard.
- I. Drawers: Fabricate with front, bottom, and back rabbeted in sides and secured with glue and mechanical fasteners as follows:
 - 1. Subfronts, Sides, and Backs: 3/8-inch- (9.5-mm-) thick particleboard.
 - 2. Bottoms: Not less than 1/4-inch- (6.4-mm-) thick particleboard.
 - 3. Drawer Suspension: Provide for a minimum capacity of 50 lbf (220 N), with twin-track, side-mounted, drawer-glide suspension with nylon rollers. Provide self-closing feature and positive stop.

- J. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.
- K. Subbase: 3/4-inch- (19-mm-) thick particleboard.
- L. Toe Board: 5/8-inch- (16-mm-) thick particleboard attached to subbase with concealed fasteners.

2.4 CASEWORK HARDWARE

- A. General: Manufacturer's standard units complying with ANSI A156.9, of type, material, size, and finish as selected by Owner from manufacturer's standard choices.

2.5 COUNTERTOPS, PLASTIC LAMINATE

- A. General: Comply with ANSI A161.2.
 - 1. Provide color through plastic laminate.
- B. Plastic Laminate Substrate: Comply with ASTM D 1037.
 - 1. Particleboard: Comply with ANSI A208.1, 45-lb/cu. ft. (720-kg/cu. m) density, not less than 3/4 inch (19 mm) thick.
 - 2. Medium-Density Fiberboard: Comply with ANSI A208.2, not less than 3/4 inch (19 mm) thick.
- C. Plastic Laminate Substrate for Countertop with Sink: Exterior grade plywood or phenolic resin particleboard complying with ASTM D 1037.
- D. Backer Sheet: Provide BK 20 backer sheet wherever the unsupported countertop area exceeds 4 sq. ft. (0.37 sq. m) and substrate is 3/4 inch (19 mm) thick; 6 sq. ft. (0.56 sq. m) and substrate is 1 inch (25 mm) thick; 8 sq. ft. (0.74 sq. m) and substrate is 1-1/8 inch (29 mm) or thicker.
- E. Countertop, Backsplash, and Endsplash Plastic Laminate: GP 50.
- F. Configuration: Provide countertops with the following front style, cove, and backsplash style:
 - 1. Front Style: Rolled.
 - 2. Cove: Cove molding.
 - 3. Backsplash and Endsplash Style: Curved or waterfall shape with scribe.

3. PART 3 EXECUTION

3.1 INSTALLATION

- A. Install cabinets with no variations in flushness of adjoining surfaces using concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.
- B. Install cabinets without distortion so that doors and drawers fit openings properly and are aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessories as indicated.
- C. Install cabinets and countertop level and plumb to a tolerance of 1/8 inch in 8 feet (3 mm in 2400 mm).
- D. Fasten unit of casework to adjacent unit and into structural support members of wall

construction with #10 sheet metal or wood screws with washer head or washer.

- E. Fasten plastic laminate countertops by screwing through corner blocks in base units into underside of countertop. Spline and glue joints in countertops and provide concealed mechanical clamping of joint.

3.2 ADJUSTING AND CLEANING

- A. Adjust hardware to center doors and drawers in openings and lubricate to provide unencumbered operation.
- B. Clean cabinets on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 07 21 13

BOARD INSULATION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation under slab and foundation construction.

1.2 RELATED SECTIONS

- A. Section 033000 - Cast-In-Place Concrete.
- B. Section 042000 - Unit Masonry.

1.3 REFERENCES

- A. ASTM C272 - Water Absorption.
- B. ASTM C518 - Thermal Resistance.
- C. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.
- D. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.
- E. ASTM D1621 - Compressive Strength.
- F. ASTM C203 - Flexural Strength.
- G. ASTM D2126 - Dimensional Stability.

1.4 PERFORMANCE REQUIREMENTS

- A. Materials of this Section shall provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials.
- B. Materials of this Section shall provide continuity of vapor and air barrier at building enclosure elements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 013300 - Submittals.
- B. Product Data: Provide data on product characteristics, performance criteria and limitations.
- C. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation and installation techniques.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.7 COORDINATION

- A. Coordinate work under provisions of Section 011000 - Summary of Work and Section 013000 - Coordination and Meetings.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

- A. Dow Chemical Company, Product: Styrofoam.
- B. Dow Brand Square Edge or Score Board (below grade exterior) & Dow Z-mate interior with z purlins above grade or approved equal.
- C. Dow Chemical Company, Product: Tapered Styrofoam.
- D. GAF Materials Corporation: Energyguard Tapered Perlite Insulation Systems.
- E. Firestone Building Products: Tapered ISO 95+.
- F. Substitutions: Under provisions of Section 01600 - Material Equipment.

2.2 INSULATION MATERIALS - BOARD INSULATION

- A. Polystyrene Insulation:ASTM C578 Type VI; extruded cellular type, conforming to the following.
 - 1. Thermal Resistance: R of 6.5 @40 F per inch of thickness.
 - 2. Thickness: As shown on the drawings.
 - 3. Board Size: 48 inch x 96 inch.
 - 4. Compressive Strength: Minimum 25 psi.
 - 5. Water Absorption:In accordance with ASTM C272; 0.1 percent by volume maximum.
 - 6. Edges:Square edges.

2.3 INSULATION MATERIALS - POLYSTYRENE INSULATION TYPE A

- A. Thermal Resistance:R of 6.5 or greater per inch of thickness.
- B. Thickness: As indicated, minimum 1 1/2 inches for exterior walls. Board Size 48" x 96".
- C. Compressive Strength:Minimum 15 psi
- D. Water Absorption In accordance with ANSI/ASTM D2842, 4 percent by volume maximum edges square.

2.4 ACCESSORIES

- A. Separator Sheet: Black polyfilm 4 mils thick minimum.
- B. Tape: Polyethylene self-adhering type, 2 inch wide.
- C. Insulation Fasteners: not used.
- D. Adhesive: Type recommended by insulation manufacturer for application.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.
- B. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.
- C. Verify substrate surface is flat, free of honeycombs, fins, irregularities, and free of materials or substances that may impede adhesive bond.

3.2 INSTALLATION - EXTERIOR WALLS

- A. Apply type of adhesive recommended by insulation board manufacturer.
- B. Install boards on wall surface, vertically.
- C. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.
- D. Tape insulation board joints.

3.3 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 015000 - Construction Facilities and Temporary Controls.
- B. Protect Work from damage prior to covering insulation.

END OF SECTION

SECTION 07 21 16

BLANKET INSULATION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Batt insulation and vapor barrier.
- B. Batt insulation for filling perimeter window and door shim spaces, and crevices in exterior walls.

1.2 RELATED SECTIONS

- A. Section 061000 - Rough Carpentry.
- B. Section 072113 - Board Insulation.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- B. FS HH-I-521 - Insulation Blankets, Thermal, Mineral Fiber for Ambient Temperatures.

1.4 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, limitations, and thermal resistance ratings.
- B. Submit under provisions of Section 013300.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

- A. Owens Corning Product - Thermal Batt Insulation.
- B. Or Engineer approved equal.

2.2 MATERIALS

- A. Batt Insulation: Preformed glass fiber batt; conforming to the following:
 - 1. Thermal Resistance: As indicated on drawings.
 - 2. Batt Size: 16 and 24 inch width.
 - 3. Facing faced on one side with kraft or foil faced vapor barrier.
 - 4. S.A.B.: Sound Attenuation Batts, unfaced, lightweight, flexible fiberglass insulation batts, designed to deliver noise control in metal stud wall cavities of interior partitions.
- B. Staples: Steel wire; galvanized; type and size to suit application.
- C. Tape: Polyethylene or Polyester self-adhering type, mesh reinforced, 2 inch wide.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.
- B. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

- A. Install insulation and vapor barrier in accordance with insulation manufacturer's instructions.
- B. Install in exterior ceiling spaces without gaps or voids.
- C. Trim insulation neatly to fit spaces.
- D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.
- E. Install with factory applied membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
- F. Staple in place at maximum 6 inches on center.
- G. Tape seal butt ends, lapped flanges, and tears or cuts.
- H. Wood Framing: Place vapor and air barrier on warm side of insulation by stapling at 6 inches on center. Lap and seal sheet barrier joints over member face.
- I. Extend vapor and air barrier tight to full perimeter of adjacent window and door frames and other items interrupting the plane of membrane. Tape seal in place.

- J. When installing insulation, do not obstruct air flow from soffit vents to ridge vents. Install insulation baffles.

3.3 SCHEDULES

- A. Wall Insulation: R-21 batt, faced.
- B. Roof Insulation: R-38 batt, faced.

END OF SECTION

SECTION 07 21 19

FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Water-blown, closed cell, polyurethane spray foam insulation.
- B. Related Sections:
 - 1. Section 042000 - Unit Masonry.
- C. Coordinate mechanical ventilation and fresh air supply with Mechanical sections and ASHRAE Guidelines for optimum indoor air quality.

1.3 REFERENCES

- A. American Society for Testing and Materials International (ASTM)
 - 1. ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 2. ASTM C 1338: Standard Test method for Determining Fungi Resistance of Insulation Materials and Facings
 - 3. ASTM E 84: Test Method for Surface Burning Characteristics of Building Materials
 - 4. ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials
 - 5. ASTM E119: Standard Test Methods for Fire Tests of Building Construction and Materials
 - 6. ASTM E 2178: Standard Test Method for Air Permeance of Building Materials
 - 7. NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non Load-Bearing Wall Assemblies Containing Combustible Components

1.4 SUBMITTALS

- A. Product Data for type of insulation product specified.
- B. Product test reports performed by a qualified third-party testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, and other properties, based on comprehensive testing of current products.
- C. Evaluation Report: Evidence of compliance of foam-plastic insulations with International Building Code (IBC), International Residential Code (IRC), International Energy Conservation Code (IECC).

- D. Manufacturer's certificate certifying insulation provided meets or exceeds specified requirements.
- E. Installer's certificate showing the Manufacturers installation certification.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Product produced in an ISO 9001 registered factory.
- B. Single Source Responsibility: Single source product from one manufacturer.
- C. Installer Qualifications: Engage a Manufacturer's licensed Contractor (installer) who has been trained and certified by Manufacturer.
- D. Fire-Test-Response Characteristics: Provide materials specified as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84
 - 2. Rated Wall Assembly Testing: ASTM E119 and ASTM 285

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for handling and protection prior to and during installation.
- B. Store both components in a temperature-controlled area between 60 and 85 degrees F. Do not allow product to freeze.
- C. Use only those components that are supplied by the Manufacturer.

1.7 PROJECT CONDITIONS

- A. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

1.8 WARRANTY

- A. Residential projects: Manufacturer's standard limited lifetime warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Polyurethane Spray Foam Insulation:
 - 1. Tailored Foam Core-Fill 500 pressure-injected foam
 - 2. ProSeal Eco by Icynene Inc.
 - 3. InsulBloc and InsulStar by NCFI Polyurethanes
 - 4. Quik-Shield 450 and Quik-Shield 112XC by SWD Urethane
 - 5. Substitutions: As specified in Section 016000 - Product Requirements.

2.2 MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
- B. Spray Foam Insulation: Medium-density, closed cell, rigid, two component, spray applied, polyurethane system., conforming to the following:
 - 1. Thermal Resistance (R), ASTM C518 at 180 days aged: 6.3 degrees F. ft²; h/Btu at 1 inch thickness and 6.5 degrees F. ft²; h/Btu at 3.5 inch thickness, minimum.
 - 2. Water Vapor Permeability, ASTM E96: 0.93 per 1.2 inch, maximum.
 - 3. Water Absorption, Percent by Volume, ASTM D2842: 1.0 percent, maximum.
 - 4. Air Leakage, ASTM E283: 0.002 L/s-m².
 - 5. Core Density, ASTM D1622: 1.8 to 2.3 lb./ft.²
 - 6. Tensile Strength, ASTM D1623: 22.3 to 25 psi.
 - 7. Flame Spread, ASTM E84: 25, maximum.
 - 8. Smoke Developed, ASTM E84: 450, maximum.
- C. Product Description: Medium-density, closed cell, rigid, two component, spray applied, polyurethane system.

2.3 SOURCE QUALITY CONTROL

- A. Product produced in an ISO 9001 registered factory.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.
 - 1. Review placement area to determine final location will not be within 3 inches of any heat source where the temperature will exceed 180 deg F per ASTM C 411 or in accordance with authorities having jurisdiction.

3.2 PREPARATION

- A. Clean substrates and cavities of loose materials capable of interfering with insulation placement.

3.3 APPLICATION

- A. Site mix liquid components supplied by Manufacturer and installed by manufacturers licensed/approved applicator.
- B. Apply insulation to substrates in compliance with manufacturer's written instructions.
- C. Apply insulation to produce thickness required for indicated R Value.
- D. Extend insulation in thickness indicated to envelop entire area to be insulated.

- E. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.4 REPAIRS

- A. Any repairs must be effected by an Manufacturer Licensed Contractor.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse.

END OF SECTION

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Window and door flashing, vapor-[permeable][impermeable] air and water-resistive barrier membrane system, and accessory materials for application to exterior building envelope substrates as indicated on the drawings.

B. Related Requirements:

1. Section 01 33 00- Submittal Procedures.
2. Section 01 45 80- Testing Laboratory Services.
3. Section 01 60 00- Product Requirements.
4. Section 03 11 19- Insulating Concrete Forming
5. Section 07 65 00- Flexible Flashing.
6. Section [0X XX XX- Section Title].

1.2 REFERENCES

- A. The date of the standard is that in effect as the date of receipt of bids for the project.
- B. Living Building Challenge (LBC).
- C. ASTM International (ASTM):

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene before the start of installation of air and water-resistive barrier system.

1. Require attendance of parties directly affecting work of this Section, including the Owner's Representative, Contractor, Architect, installing subcontractor, membrane system manufacturer's representative, roofing and foundation waterproofing subcontractors, and all subcontractors who have materials penetrating membrane system or finishes covering membrane system.
2. Contractor shall notify Architect at least seven days prior to time for conference.
3. Contractor shall record minutes of meeting and distribute to attending parties.
4. Review the following:
 - a. Surface preparation.
 - b. Substrate condition and pretreatment.
 - c. Minimum curing period.
 - d. Special details and sheet flashing.
 - e. Sequence of construction, responsibilities, and schedule for subsequent operations.
 - f. Installation procedures.
 - g. Inspection procedures.
 - h. Protection and repair procedures.
 - i. Review and approval of all glazing applications.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance requirements: Comply with the specified performance requirements and characteristics as herein specified.

- B. Performance description:
1. The building envelope shall be constructed with a continuous, air and water-resistive barrier to control air leakage, avoid condensation in the interior wall assembly and prevent water intrusion.
 2. Joints, penetrations and paths of water and air infiltration shall be made watertight and airtight.
 3. System shall be capable of withstanding positive and negative combined wind, stack and HVAC pressures on the envelope without damage or displacement.
 4. System shall be installed in an airtight and flexible manner, allowing for the relative movement of systems due to thermal and moisture variations.

1.5 SUBMITTALS

- A. Product data:
1. Submit manufacturer's product data and installation guidelines, including membrane and accessory material types, technical and test data, composition, descriptions and properties, installation instructions and substrate preparation requirements.
- B. Certificates:
1. Certificates by manufacturer stating that manufacturer and installer meet qualifications as herein specified.
- C. VOC Certification: Submit certification that products furnished comply with regulations controlling use of volatile organic compounds (VOC).

1.6 QUALITY ASSURANCE

- A. Applicable standards, as referenced herein: ASTM International (ASTM).
- B. Manufacturer's qualifications: Air and water-resistive barrier systems shall be manufactured and marketed by a company with a minimum of five (5) years' experience in the production and sales of air and water-resistive barrier system. Manufacturers proposed for use, but not named in these specifications, shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.
- C. Installer's qualifications: The installer shall demonstrate qualifications to perform the work of this section by submitting the following:
1. Verification that the installer completed SWR Institute's Validated Air Barrier Training and is approved to perform work as herein specified by air and water-resistive barrier system manufacturer.
 2. List of at least three (3) projects completed of similar scope and complexity to this project carried out by the firm and site supervisor.
- D. Inspection and testing: Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover installed products or assemblies until they have been inspected, tested and approved.
- E. Sole source: Obtain materials within the scope of this specification from a single manufacturer.
- F. Regulations: Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOC).
- G. Mock-up:
1. Prior to installation of the weather and air barrier system a field-constructed mock-up shall be applied to verify details and tie-ins, to demonstrate the required installation.
 - a. Construct a typical exterior wall section, 8 feet long and 8 feet wide, incorporating back-up wall, cladding, window, door frame, sill, penetrations, insulation, flashing and any other critical junction.

- b. Allow 72 hours for inspection and testing of mock-up before proceeding with weather and air barrier work.
- c. Coordinate construction of mockups to permit inspection by [Architect] [Owner's Representative] of air barrier before beginning installation.
- d. Approved, undamaged mock-up must remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures and construction operations. Remove damaged material from site and dispose of in accordance with applicable regulations.
- B. Protect air and water-resistive barrier components from freezing and extreme heat.
- C. Sequence deliveries to avoid delays, and to minimize on-site storage.

1.8 FIELD CONDITIONS

- A. Environmental limitations:
 - 1. Comply with manufacturer's written instructions for substrate temperature and moisture content and other conditions affecting performance requirements.
- B. Weather conditions:
 - 1. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used.
- C. Proceed with installation only when the substrate construction and preparation work are complete and in condition to receive the membrane system.
- D. Do not apply to frozen substrate. Allow adequate time for substrate to thaw, if freezing conditions exist before application.
- E. Ultra-Violet (UV) Exposure:
 - 1. Do not expose air barrier materials to sunlight and weather longer than as recommended by the material manufacturer.

1.9 WARRANTY

- A. Manufacturer's warranty requirements:
 - 1. Submit manufacturer's 5-year limited warranty stating:
 - a. The products have been tested in accordance with national standards for air and water-resistive barriers and passed those tests with effectiveness and durability indicating their suitability for performance as an air and water-resistive barrier system when properly applied.
 - b. The products shall be free from defects in material for a period of five years after the substantial completion of the material application.
 - c. That the products will not disintegrate and will maintain their integrity over the life of the warranty.
- B. Warranty period: Five (5) years from Date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Substitutions: [No Substitutions] [In accordance with Section 01 25 00 – Substitution Procedures].

2.2 VAPOR- PERMEABLE MEMBRANE AIR-BARRIER

- A. Fluid applied, Vapor-Permeable air and water-resistive barrier that stops air and water leakage in cavity wall, masonry veneer construction, as well as in stucco, EIFS and most other building wall assemblies.
1. Product: PROSOCO [R-Guard Spray Wrap MVP](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
 1. Product: PROSOCO [R-Guard Spray Wrap Rain Screen \(RS\)](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Subject to compliance with the following physical and performance requirements:
1. Living Building Challenge 2.0/2.1/3.0/3.1 Red List.
 2. ICC-ES AC 212 Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing.
 3. ABAA: Air Barrier Association of America Acceptance Criteria for Liquid Applied Membranes.
 4. Comply with national, state and district AIM VOC regulations and less than 30 grams per Liter.
 5. Vapor Permeance: Minimum 10 perms when tested in accordance with ASTM E96 (Wet Cup).
 6. Tensile bond: Minimum 15 psi or exceeds strength of substrate when tested in accordance with ASTM C297.
 7. Surface Burning Characteristics: Class A Building Material, when tested in accordance with ASTM E84. Flame Spread: Equal or less than 25, Smoke Developed: Equal or less than 450.
 8. Total solids: 63 to 68- percent by volume, ASTM-D-2369.
- A. Fluid applied air and water-resistive barrier that combines silicone and polyurethane properties. Single component, Silyl-Terminated-Polymer (STP) that is spray or roller applied to produce a highly durable, seamless, elastomeric weatherproofing membrane on exterior sheathing, CMU back-up walls, and pre-cast concrete. Prevents water and air penetration of the building envelope in weather up to 155 mph winds of a Category 5 hurricane.
1. Product: PROSOCO [R-Guard Cat 5](#) manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- A. Fluid applied, air and water-resistive barrier membrane that combines silicone and polyurethane properties. Single component, Silyl-Terminated-Polymer (STP) that is spray or roller applied to produce a highly durable, seamless, elastomeric weatherproofing membrane on exterior building envelope substrates, in addition to behind open-jointed or vented rain screen cladding. Prevents water and air penetration of the building envelope in weather up to 155 mph winds of a Category 5 hurricane.
1. Product: PROSOCO [R-Guard Cat 5 Rain Screen \(RS\)](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Roller Equipment: Provide a standard three-eighths (3/8) inch to three-fourths (3/4) inch nap roller.
- C. Airless Spray Equipment: Provide direct immersion equipment for controlled spray application of fluid-applied air and water resistive barrier, at 3500psi to 4000 psi pressure, measured at spray tip, per manufacturer's published recommendations.
- a. Provide:
 - 1) GH 833DI, GH 933DI, GH 675DI (Direct Immersion) by Graco.
 - 2) PowrTwin 12000 Plus DI (Direct Immersion) by Titan.
 - 3) Approved equal.
 - b. Accessories:
 - 1) Hose:

- a) Half (1/2) inch ID greater or equal to 4000 psi.
- 2) Whip:
 - a) Three-eighths (3/8) inch whip and gun swivel.
- 3) Gun:
 - a) HD Blue 241706 by Graco.
 - b) RX Apex by Titan.
- 4) Tip:
 - a) 523 Reversible.
 - b) HD 523 Reversible tip.

B. Subject to compliance with the following physical and performance requirements:

1. Living Building Challenge 2.0/2.1/3.0/3.1 Red List.
2. ICC-ES AC 212 Acceptance Criteria for Water-Resistive Coatings Used as Water Resistive Barriers Over Exterior Sheathing.
3. ABAA: Air Barrier Association of America Acceptance Criteria for Liquid Applied Membranes.
4. Comply with national, state and district AIM VOC regulations and less than 30 grams per Liter.
5. Air Leakage of Air Barrier Assemblies: Less than or equal to 0.04 cfm per square foot at 1.57 psf (less than or equal to 0.2 liters s·sq.m. at 75 Pa) when tested in accordance with ASTM E2357.
6. Air Permeance: Less than or equal to 0.004 cfm per square foot (Less than or equal to 0.02 L/s/sq m) when tested in accordance with ASTM E2178.
7. Vapor Permeance: Minimum 10 perms when tested in accordance with ASTM E96 (Wet Cup).
8. Total solids: 99 percent.

2.3 VAPOR- IMPERMEABLE MEMBRANE AIR-BARRIER

A. Fluid-applied air and water-resistive vapor barrier that stops air and water leakage in cavity wall, masonry veneer construction, as well as in stucco, EIFS, and most other building wall assemblies.

1. Product: [PROSOCO R-Guard VB](http://www.prosoco.com), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.

B. Subject to compliance with the following physical and performance requirements:

1. Comply with national, state and district AIM VOC: less than 50 grams per Liter
2. Air Leakage of Air Barrier Assemblies: Less than or equal to 0.04 cfm per square foot at 1.57 psf (less than or equal to 0.2 liters s·sq.m. at 75 Pa) when tested in accordance with ASTM E2357.
3. Air permeance: Less than or equal to 0.004 cfm per square foot (Less than or equal to 0.02 L/s/sq m) when tested in accordance with ASTM E2178.
4. Vapor Permeance: Maximum 0.1 perms when tested in accordance with ASTM E96 (Dry Cup).
5. Surface Burning Characteristics: Class A Building Material, when tested in accordance with ASTM E84. Flame Spread: Equal or less than 25, Smoke Developed: Equal or less than 450.
6. Water resistance: No water infiltration after exposure to 55 cm head of water for 5 (five) hours when tested in accordance with ICC-ES AC 212 AATCC 127.
7. Fastener sealability: No water infiltration when tested in accordance with ASTM D1970.
8. Total solids: 62.5 percent.

2.4 WATER BASED PRIMER FOR RAW GYPSUM BOARD EDGES

A. Primer to seal the cut edges of gypsum wall boards where they are exposed in rough openings for windows and doors. The sealed edge makes a compatible surface for easy application of liquid applied fiber-reinforced fill coat and seam treatment for through-wall components.

1. Product: PROSOCO [R-Guard PorousPrep](http://www.prosoco.com), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.

B. Subject to compliance with the following physical and performance requirements:

1. Breathable liquid primer.
2. Comply with national, state and district AIM VOC regulations and be 100 g/L or less.
3. Living Building Challenge 2.0/2.1/3.0/3.1 Red List.

4. Total solids: 16 percent.

2.5 LIQUID APPLIED FILL COAT AND SEAM FILLER

- A. High modulus, gun-grade, crack and joint filler, adhesive and detailing compound that combines the best silicone and polyurethane properties. The single-component, Silyl-Terminated-Polymer (STP) prepares open joints, seams and cracks before installing primary water and air barrier system to prevent the movement of water and air through building envelopes.
 1. Product: PROSOCO [R-Guard Joint & Seam Filler](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Subject to compliance with the following physical and performance requirements:
 1. Living Building Challenge 2.0/2.1/3.0/3.1 Red List.
 2. Comply with national, state and district AIM VOC regulations and be 30 g/L or less.
 3. Water vapor transmission: Minimum 19 perms at 20 mils when tested in accordance with ASTM E-96.
 4. Tensile strength: 70 psi when tested in accordance with ASTM D412.
 5. Elongation at break: Greater than 180 percent when tested in accordance with ASTM D412.
 6. Peel strength: Greater than 25 pli when tested in accordance with ASTM D1781.
 7. Total solids: 99 percent.
- A. Single-Component, Water-based, gun-grade, crack and joint filler that prepares open joints, seams, and cracks before installing primary water and air barrier system to prevent the movement of water and air through building envelopes.
 1. Product: PROSOCO [R-Guard Joint & Seam Filler WB](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Subject to compliance with the following physical and performance requirements:
 1. Comply with national, state and district AIM VOC regulations and be 30 g/L or less.
 2. Total solids: 87 percent.
 1. Product: PROSOCO [R-Guard FastFlash](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Subject to compliance with the following physical and performance requirements:
 1. Living Building Challenge 2.0/2.1/3.0/3.1 Red List.
 2. AAMA 714-12 Voluntary Specification for Liquid-Applied Flashing Used to Create a Water-Resistive Seal Around Exterior Wall Openings in Buildings.
 3. ICC-ES AC 212 Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing.
 4. Comply with national, state and district AIM VOC regulations and be 30 g/L or less.
 5. Water vapor transmission: 21 perms when tested in accordance with ASTM E96.
 6. Tensile strength: Greater than 150 psi when tested in accordance with ASTM D412.
 7. Elongation at break: Greater than 350 percent when tested in accordance with ASTM D412.
 8. Total Solids: 99 percent.

2.6 LIQUID-APPLIED FLASHING AND DETAILING MEMBRANE

- A. Gun-grade, spread and tool or roller apply waterproofing, adhesive and detailing compound that combines the best of silicone and polyurethane properties. The single component, Silyl-Terminated-Polymer (STP) produces a highly durable, seamless, elastomeric should treat joints, seams, cracks and provide the flashing membrane in rough openings of structural walls and to counter-flash waterproofing and air barrier components.
 1. Product: PROSOCO [R-Guard FastFlash](#) manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Subject to compliance with the following physical and performance requirements:

1. Living Building Challenge 2.0/2.1/3.0/3.1 Red List.
2. AAMA 714-12 Voluntary Specification for Liquid-Applied Flashing Used to Create a Water-Resistive Seal Around Exterior Wall Openings in Buildings.
3. ICC-ES AC 212 Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing.
4. Comply with national, state and district AIM VOC regulations and be 30 g/L or less.
5. Water vapor transmission: 21 perms when tested in accordance with ASTM E96.
6. Tensile strength: Greater than 150 psi when tested in accordance with ASTM D412.
7. Elongation at break: Greater than 350 percent when tested in accordance with ASTM D412.
8. Total Solids: 99 percent.

2.6 INTERIOR SEALANT FOR WINDOWS AND DOORS

- A. High performance, gun-grade waterproofing sealant that combines the silicone and polyurethane properties. Single component, Silyl-Terminated-Polymer (STP) that is that is durable, and stops the movement of moist air through cracks surrounding windows and doors.
 1. Product: PROSOCO [R-Guard AirDam](#), manufactured by PROSOCO, Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Subject to compliance with the following physical and performance requirements:
 1. Living Building Challenge 2.0/2.1/3.0/3.1 Red List.
 2. Comply with national, state and district AIM VOC: less than 30 grams per Liter.
 3. Sealant Validation from Sealant Waterproofing & Restoration Institute (SWRI).
 4. Elongation at break: Greater than 1000% when tested in accordance with ASTM D412.
 5. Peel strength: 25 pli when tested in accordance with ASTM C794
 6. Total solids: 98 percent.
- C. Backer rod: In deep joints, control sealant depth by installing closed cell backer rod. Diameter of the soft-backer rod should be 25 percent greater than the joint width. Do not puncture backer rod.

2.7 PREFORMED SILICONE SEALANT EXTRUSION

- A. Manufacturer's standard system consisting of pre-cured low modulus elastomeric extrusion that provides a continuous transition and bridges [windows and doors frames at curtain wall] [storefront] [expansion joints] [skylights] [roof] to air barrier materials. Provide continuous Preformed Silicone Sealant Extrusion System that is flexible, durable, designed for high dynamic and thermal movement which is resistant to ultraviolet exposure and weathering.
 1. Product: PROSOCO [R-Guard SureSpan EX](#), manufactured by PROSOCO Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.
- B. Subject to compliance with the following physical and performance requirements:
 1. Elongation: Minimum 400 percent when tested in accordance to ASTM D412.
 2. Joint Movement Capacity: Minimum 200 percent elongation and minimum 75% compression per ASTM C1518 (ASTM C1523).
 3. Tensile Strength: Minimum 700 psi when tested in accordance with ASTM D412.
 4. Tear Strength: Minimum 200 lb/in when tested in accordance with ASTM D624.
 5. Tear Propagation: Pass testing requirements of ASTM C1518 (ASTM C1523). Movement Class shall exceed 200 percent Elongation and a Tear Class of PT (Knotty Tear).
 6. Shore Hardness A: 50 to 65 when tested in accordance with ASTM D2240.
 7. UV Resistance: No degradation of material when exposed to UV.
- C. Manufacturer's Silyl-Terminated-Polymer (STP) extrusion adhesive designed to adhere and seal silicone sealant extrusion.
 1. Product: PROSOCO [R-Guard SureSpan Adhesive](#), manufactured by PROSOCO Inc., Lawrence, KS, (800) 255-4255, www.prosoco.com.

PART 3 - EXECUTION

3.1 EXAMINATION AND SURFACE PREPARATION

- A. Examine conditions for compliance with system manufacturer's requirements for installation, and other specific conditions affecting performance of air barrier system.
- B. All surfaces must be sound, clean and free of surface oxidation, grease, dirt, excess mortar or other contaminants detrimental to application. Fill or bridge damaged surfaces, voids or gaps larger than one- inch. Fill voids and gaps measuring one- inch or less with liquid applied fill coat and seam filler as necessary to ensure continuity.
 - 1. Surfaces to receive primary fluid applied air and water barrier must be dry or damp, unless approved by air barrier manufacturer. Surfaces to receive (STP) fluid applied accessories must be dry, damp or wet to the touch. Brush away any standing water present before application. STP products will tolerate rain immediately after application.
 - 2. Insulated concrete form (ICF) building system surfaces to receive fluid applied primary air and water barrier and accessories must be cleaned to remove surface contaminants that inhibit adhesion prior to application. Preferred method for cleaning oxidation from surface is with water and low-pressure cleaning.
- C. Refer to manufacturer's product data sheets for requirements for condition of and preparation of substrates.
 - 1. Surfaces shall be sound and free of voids, spalled areas, loose aggregate and sharp protrusions.
 - 2. Remove contaminants such as grease, oil and wax from exposed surfaces.
 - 3. Remove dust, dirt, loose stone and debris.
 - 4. Use repair materials and methods that are acceptable to manufacturer of the air and water-resistive barrier system.
 - 5. Refer to manufacturer's product data sheets and manufacturer's installation guidelines for additional information on preparing structural walls to receive the primary air and water resistive barrier.
- D. Exterior sheathing:
 - 1. Ensure that sheathing is properly installed with ends, corners and edges properly fastened. Remove and replace damaged sheathing.
 - 2. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing, and spot overdriven fasteners with liquid applied fill coat and seam filler.
 - 3. Seal the cut edges of gypsum wall boards exposed in rough openings for windows and doors at corners, as recommended by manufacturer.
- E. Masonry and concrete substrates:
 - 1. Masonry head and bed joints should be fully filled and tooled.
 - 2. Mechanically remove loose mortar fins, mortar accumulations and protrusions, and debris.
 - 3. Fill cracks, joints and gaps with liquid applied fill coat and seam filler as herein specified.

3.2 FIBER REINFORCED FILL COAT AND SEAM FILLER

- A. General: Comply with weather and air barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply liquid applied fill coat and seam filler for seams, joints, cracks, gaps, primed rough gypsum edges at sheathing, rough openings per manufacturer's written instructions.

3.3 LIQUID APPLIED FLASHING AT WINDOWS, DOORS, OPENINGS AND PENETRATIONS

- A. General: Comply with weather and air barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.

- B. Apply liquid flashing membrane over surfaces to seal and waterproof rough openings per manufacturer's written instructions. Spread the wet product to create an opaque, monolithic flashing membrane which surrounds the rough opening and extends 4 to 6 inches over the face of the structural wall. Apply additional coats as needed to achieve void- and pinhole-free surface.

3.4 FLUID-APPLIED AIR & WATER-RESISTIVE BARRIER INSTALLATION

- A. General: Comply with weather and air barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply air and water-resistive barrier to a clean, dry substrate within temperature and weather limitations per manufacturer's written instructions; use roller or spray application methods, at Contractor's option.
 1. Apply to recommended thickness.
 2. Allow product to cure and dry.
 3. Inspect membrane before covering. Repair any punctures or damaged areas by applying additional material.
 4. Back roll as necessary to ensure there are no pinholes, voids or gaps in the membrane. Apply fluid applied air and water-resistive barrier per manufacturer's recommendations.
 5. Apply additional coats per manufacturer's written instructions.

3.5 FLUID-APPLIED FLASHING TRANSITIONS

- A. General: Comply with weather and air barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply fiber reinforced fill coat and seam filler and liquid flashing membrane as a liquid flashing membrane to waterproof the transitions in rough opening and between dissimilar materials per manufacturer's written instructions.
 1. Fill any voids between the top of the flashing leg and the vertical wall with fiber reinforced fill coat and seam filler.
 2. Spread the wet liquid flashing membrane to create a monolithic "cap-flash" flashing membrane per manufacturer's written instructions.
 3. Apply additional coats as needed to achieve void- and pinhole-free surface.
 4. Allow treated surfaces to skin before installing other wall assembly, waterproofing or air barrier components.
- B. Apply preformed silicone sealant extrusion to provide a continuous airtight and water-tight seal between material frame and substrate per manufacturer's written instructions.
 1. Embed material in bead of liquid flashing membrane per manufacturer's written instructions.

3.6 INTERIOR SEALANT FOR WINDOWS AND DOORS INSTALLATION

- A. General: Comply with weather and air barrier manufacturer's installation instructions, temperature limitations, product data and shop drawings.
- B. Apply interior waterproofing sealant per manufacturer's written instructions.
 1. Install Backer rod: Compressible, closed cell rod stock as recommended by manufacturer for compatibility with sealant. Install Backer Rod as necessary per manufacturer's written instructions.
 2. Apply interior waterproofing sealant in continuous beads without gaps or air pockets.

3.7 PROTECTION

- A. Coordinate scheduling within installation of cover materials to ensure that fluid-applied air barrier system is not exposed to sunlight and weather longer than recommended by the system manufacturer.

- B. Ensure that the top edge of the fluid-applied air barrier and the roofing system is capped and sealed from water intrusion. Ensure the continuity of the fluid-applied air barrier system has been achieved.

END OF SECTION

SECTION 07 40 00

METAL ROOFING AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Prefinished metal roofing.
- B. Fasteners, anchorages, connectors, bolts and other components and material required for complete and watertight installation.

1.2 RELATED SECTIONS

- A. Section 01 33 00 - Submittals.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 06 17 53 - Shop-Fabricated Wood Trusses.
- D. Section 07 42 13 - Metal Wall Panels.
- E. Section 07 61 00 - Preformed Metal Fascia, and Accessories.

1.3 REFERENCES

- A. Federal Specification (Fed Spec):
 - 1. TT-P-31 - Paint, Oil: Iron-Oxide, Ready Mixed, Red and Brown.
- B. Steel Deck Institute (SDI): "Steel Roof Deck Design Manual".
- C. Building code and other applicable regulations of governing authorities having jurisdiction at project site.

1.4 SYSTEM DESCRIPTION

- A. Wall and Roof System: Preformed metal panels of vertical profile and accessory components.

1.5 SUBMITTALS

- A. Product Data: Three copies of manufacturer's specifications and descriptive literature.
- B. Material and Color Samples
 - 1. For each specific material sample requested by Architect, submit in size, form, and number directed.
 - 2. Submit duplicate color sample sets showing full color range available, for selection purposes.

- C. Installation and Maintenance Instructions: Submit complete installation and maintenance instructions of all components.
- D. Submit color selection to Owner for review prior to applying final coat of paint finish.

1.6 QUALITY ASSURANCE

- A. The manufacturer shall not have less than 15 years experience in manufacture of systems building and shall be a member of MBMA.
- B. Builders and erectors shall not have less than 5 years experience in erecting metal roofing similar to those required for the project.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store prefabricated components, sheets, panels, and other manufactured items so that they will not be damaged or deformed.
- B. Stack materials on platforms or pallets, covered with tarps or other approved weathertight ventilated covering.
- C. Store metal sheets and panels so water accumulation will drain freely. Do not store sheets and panels in contact with other materials which might cause staining.
- D. Store material to be readily accessible, with factory markings visible.
- E. Store materials in accordance with Section 01 60 00 - Material and Equipment.

1.8 WARRANTIES

- A. Provide manufacturer's written weathertightness warranty for a maximum of twenty (20) years against leaks in roof panels arising out of or caused by ordinary wear and tear under normal weather and atmospheric conditions. Warranty shall be signed by both the metal roofing system manufacturer and the metal roofing system Contractor.
- B. Provide manufacturer's standard written warranty for twenty (20) years against perforation of metal roof panels due to corrosion under normal weather and atmospheric conditions. Warranty shall be signed by metal roofing system manufacturer.
- C. Provide manufacturer's standard paint film written warranty for twenty (20) years against cracking, peeling, chalking, and fading of the coating on painted roof panel's accessories. Warranty shall be signed by building system or roof system manufacturer. Manufacturer warrants that coating shall not blister, peel, crack, chip, or experience material rust through for 20 years. For a period of 20 years chalking shall not exceed #8 ASTM and fading shall be 5 E (Hunter Units) Color Difference Units or less.

PART 2 - PRODUCTS

2.1 MATERIALS – ROOF SYSTEM

- A. Roof Panels:
 - 1. Roof panels shall be factory roll-formed panels 24 gage steel, with standing seam spacing 15” o.c., 1.5" high. The flat of the panel shall contain stiffening ribs.
 - 2. Panel finish: Manufacturer’s standard baked-on siliconized polyester finish over galvanized finish, color as selected by the Owner.
- B. Fasteners:
 - 1. Standing-Seam Roof Panels:
 - a. Panel Clips: Manufacturer’s standard concealed flat clip and fastener system. Clip is hooked low on the panel “leg” keeping the attachment close to the base of the panel, counteracting the effects of the wind uplift. Provide complete with three self-drilling anchors at each clip.
 - 2. Exposed Fasteners for Eave, End Splice, Fascia Copings and Flashings: Manufacturer’s standard self-drilling screw with hex head and neoprene sealing washer. Cap head and washer backer with 0.008-in. thick type 302 stainless steel caps. Painted or unpainted.

2.2 ACCESSORIES

- A. Accessories to be 0.040 thick aluminum factory colored:
 - a. Flashing.
 - b. Trim.
 - c. Fascia Copings.
 - d. Eave Copings.
 - e. Closure strips.
 - f. Corner Posts.
- B. Snow Retention System (Snow Bars):
 - 1. SnoBar by Action Manufacturing distributed by Snoblox-Snojax, Lemoyne, PA (800) 766-5291 www.snobarcolorbar.com or approved equal.
 - 2. Bars: 16 gauge galvanized steel bar.
 - 3. Clamps: 12 gauge one-piece stainless steel clamps with 2 “cup tipped” stainless steel set screws used at every roof seam.
 - 4. Finish: Powder coat – color to match or be similar to metal roofing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate is ready for roofing finish prior to installing metal roof panels and accessories.

3.2 ERECTION

- A. Standing Seam Roof Panels:
 - 1. General:

- a. Exercise care when cutting prefinished material to ensure cuttings does not remain on finish surface; protect factory finishes from damage.
 - b. Install roof panels with long edges running parallel to ends of building.
 - c. Arrange and nest sidelap joints so prevailing winds will blow over, not into, lapped joints. Lap ribbed sheets shall be lapped one full rib corrugation.
 - d. Apply panels and associated items for neat and weathertight enclosure.
 - e. Fasten to supports aligned, level and plumb.
 - f. Install approved-type closure to exclude weather.
 - (i) Provide mastic under fascia coping. Flash and seal roof panels at eave and elsewhere as required or shown on drawings.
2. Standing Seam Roof Panels:
- a. Install panels with positive interlock between installation clips and standing seams in a manner that will allow panels to support erection loads prior to closing of seams with seamer.
 - b. Install concealed anchor clips along each standing seam at location and spacing recommended by metal building manufacturer.
 - c. Where panel end splices occur, nest panels with 3-in. end laps and install interlocking clamping plates with factory-punched holes and sealant. Make splice independent of structure to allow for free expansion and contraction movement of panels without stress on splice.
 - d. Close standing seams with approved type motorized seamer tool, to assure complete sealant engagement and to assure structural integrity of panel-to-panel and panel-to-clip connections.
 - e. Use roof-panel-penetrating type fasteners only at eaves and end splices (when required). At these conditions, use fasteners in conjunction with clamping plates, with factory-punched holes to assure correct fastener placement, and approved butyl sealant to assure positive watertight seals.
 - f. Install fascia coping units of approved expansion joint design to accommodate expansion and contraction movement of roof panels.
 - g. Coordinate installation of accessories and items to be mounted on metal roofing.

3.3 INSTALLATION - ACCESSORIES

- A. Install flashing, trim, fascia copings, closure strips, corner posts, eave copings and other accessories and sheet metal items in accordance with manufacturer's recommendations for positive anchorage to building and weather tight mounting.

3.4 CLEANING

- A. Touch up abrasions, marks, skips or other defects in shop-primed or factory-finished painted surfaces with same type material as used for shop primer or factory painting.
- B. Remove from the site all scraps and debris left or caused by the work of this section.

END OF SECTION

SECTION 07 42 13.33

METAL COMPOSITE MATERIAL WALL PANELS.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes MCM wall panels.

1.3 DEFINITIONS

- A. DBVR: Drained and back-ventilated rainscreen system; rainscreen system designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.
- B. MCM: MCM; cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, MCM panel Fabricator and Installer, MCM sheet manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects MCM panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 4. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect MCM panels.
 - 5. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 6. Review temporary protection requirements for MCM panel assembly during and after installation.
 - 7. Review procedures for repair of panels damaged after installation.
 - 8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of MCM panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of MCM panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. MCM Panels: 12 inches long by 12 inches wide. Include fasteners, closures, and other MCM panel accessories.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
 - 1. MCM Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1407.14 and IBC 1703.5.
 - 2. MCM System Fabricator's System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting compliance code section. Base performance requirements on MCM provided.
 - a. DBVR System: Tested to AAMA 509.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For MCM panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by MCM Fabricator.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for MCM fabrication and installation.
 - 1. Build mockup of typical MCM panel assembly at a corner location on the structure and show a minimum of four panels and the typical seams between them.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.
- B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack MCM panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Remove strippable film from return legs during individual panel installation. Retain strippable protective covering on MCM panels until the installation of a building face or panel area is complete.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.11 COORDINATION

- A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Warranty on Panel Material: Manufacturer's standard form in which manufacturer agrees to replace MCM that fails within specified warranty period.
 - 1. Warranty Period: Ten years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: **Twenty** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide MCM panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Panel Deflection Limit: For wind loads, no greater than 1/60 of the span
 - 4. Framing Member Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Thermal Movements: Locate expansion and contraction points to allow for free and noiseless thermal movements from surface temperature changes.
 - 1. Temperature Change (Range): minus 20 deg F to 180 deg F, material surfaces.

2.2 MCM WALL PANELS – MCM PANELS

- A. MCM Wall Panel Systems: Provide factory-formed and -assembled, MCM wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, and accessories required for weathertight system.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ALUCOBOND®; 3A Composites USA Inc.; ALUCOBOND® Plus or comparable product:
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch thick, coil-coated aluminum sheet facings.
 - 1. Panel Thickness: 0.157 inch.
 - 2. Core: Fire retardant.
 - 3. Exterior Finish: PVDF fluoropolymer.
 - a. Color: As selected by Architect from manufacturer's full range.

4. Peel Strength: 22.5 in-lb/in. when tested for bond integrity in accordance with ASTM D1781.
 5. Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with ASTM E84.
- C. Attachment Assembly Components: EasyFix system clips and extrusions Formed from extruded aluminum 6063-T6 material.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of MCM panel system.
- B. Panel Accessories: Provide components required for a complete panel system. Match material and finish of MCM panels unless otherwise indicated.
1. MCM Panel Attachments
 - a. ALUCOBOND EasyFix 135/90 Clips
 - 1) Aluminum 6063-T6
 - 2) Finish: AAMA 611 Black Anodized Class 1
 - 3) Length: 3 in
 - b. ALUCOBOND EasyFix 135/90 Rails
 - 1) Aluminum 6063-T6
 - 2) Finish: AAMA 611Black Anodized Class 1
 - 3) Length: Continuous
- C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ALUCOBOND®; 3A Composites USA Inc.; ALUCOBOND® Axcent™ Trim or comparable product:
 2. Aluminum Trim: Formed with 0.040-inch thick, coil-coated aluminum sheet facings.
 3. Color: As selected by Architect from manufacturer's full range.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM panel manufacturer.

2.4 FABRICATION

- A. General: Fabricate and finish MCM panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 - 1. PVDF Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating MCM panels to verify actual locations of penetrations relative to seam locations of MCM panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and MCM panel manufacturer's written recommendations.

3.3 MCM PANEL INSTALLATION

- A. General: Install MCM panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving MCM panels.
 - 2. Flash and/or seal MCM panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by MCM panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as MCM panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

- B. Fasteners:
 - 1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by MCM panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support MCM wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Panel Installation: Attach MCM wall panels to supports at locations, spacings, and with fasteners recommended by Fabricator to achieve performance requirements specified.
 - 1. ALUCOBOND EasyFix DBVR System: Install using Fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by Fabricator. Attach MCM wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
 - a. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use Fabricator's standard horizontal tracks and vertical [tracks] [drain channels] that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach MCM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.
 - b. Panel Installation:
 - 1) Attach routed-and-turned flanges of wall panels to perimeter extrusions or clips with #10 or larger painted fasteners.
 - 2) EasyFix installation will allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete MCM panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by MCM panel Fabricator; or, if not indicated, provide types recommended in writing by MCM system Fabricator.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Site Verifications of Conditions:

1. Verify conditions of substrate previously installed under other Sections are acceptable for the MCM system installation. Provide documentation indicating detrimental conditions to the MCM system performance.
2. Once conditions are verified, MCM system installation tolerances are as follows:
 - a. Shim and align MCM wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- B. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as MCM panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of MCM panel installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.
- B. After MCM panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 54 03

SHEET MEMBRANE ROOFING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This specification is based on a Carlisle Sure-Weld TPO FleeceBack adhered with Flexible FAST Adhesive Roofing System. See other approved Manufacturer's listed below.

1.02 EXTENT OF WORK

- A. Provide all labor, material, tools, equipment, and supervision necessary to complete the installation of the Sure-Weld FleeceBack Adhered Roofing System including flashings and insulation as specified herein and as indicated on the drawings in accordance with the manufacturer's most current specifications and details.
- B. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.
- C. The roofing contractor shall confirm all given information and advise the building owner, prior to bid, of any conflicts that will affect their cost proposal.
- D. Any contractor who intends to submit a bid using a roofing system other than the approved manufacturers listed below must submit for pre-qualification in writing fourteen (14) days prior to the bid date. Any contractor who fails to submit all information as requested will be subject to rejection. Bids stating "as per plans and specs" will be unacceptable.

1.03 SUBMITTALS

- A. The Contractor shall submit electronic PDF submittals to the Engineer for review.
- B. Prior to starting work, the roofing contractor must submit the following:
 - 1. Electronic PDF shop drawings showing layout, details of construction and identification of materials must be submitted to the Engineer for review.
 - 2. Sample of the manufacturer's Membrane System Warranty.
 - 3. Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system and lists foremen who have received training from the manufacturer along with the dates training was received.
 - 4. Certification from the membrane manufacturer indicating the fasteners are capable of providing a static backout resistance of 10 inch pounds minimum is required.
 - 5. Certification from the membrane manufacturer indicating the membrane thickness over the reinforcing scrim (top ply membrane thickness) is nominal .015-mil or

thicker.

6. Certification of the manufacturer's warranty reserve.

C. Upon completion of the installed work, submit copies of the manufacturer's final inspection to the specifier prior to the issuance of the manufacturer's warranty.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.

B. Comply with the manufacturer's written instructions for proper material storage.

1. Store membrane on provided pallets in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable, waterproof tarpaulins. Membrane that has been exposed to the elements must be prepared with membrane cleaner prior to welding.

2. Store curable materials (adhesives and sealants) between 60°F and 80°F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60°F minimum temperature before using.

3. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.

C. Insulation must be on pallets, off the ground and tightly covered with waterproof materials.

D. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.05 WORK SEQUENCE

A. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.

B. Do not disrupt activities in occupied spaces.

C. In general the roofing work will follow the new HVAC equipment installation.

D. The Roofing Contractor shall coordinate the new roof work with the Mechanical Contractor. Roof work shall follow new mechanical HVAC work. Coordinate with Mechanical Contractor.

1.06 USE OF THE PREMISES

A. Before beginning work, the roofing contractor must secure approval from the building owner's representative for the following:

1. Areas permitted for personnel parking.
 2. Access to the site.
 3. Areas permitted for storage of materials and debris.
 4. Areas permitted for the location of cranes, hoists and chutes for loading and unloading materials to and from the roof.
- B. Interior stairs or elevators may not be used for removing debris or delivering materials, except as authorized by the building superintendent.

1.07 EXISTING CONDITIONS

- A. This is a new roof project.

1.08 TEMPORARY FACILITIES AND CONTROLS

- A. Temporary Utilities:

1. Water and power for construction purposes are available at the site and will be made available to the roofing contractor.
2. Provide all hoses, valves and connections for water from source designated by the owner when made available.
3. When available, electrical power should be extended as required from the source. Provide all trailers, connections and fused disconnects.

- B. Temporary Sanitary Facilities

Sanitary facilities will not be available at the job site. The roofing contractor shall be responsible for the provision and maintenance of portable toilets or their equal.

- C. Building Site:

1. The roofing contractor shall use reasonable care and responsibility to protect the building and site against damages. The contractor shall be responsible for the correction of any damage incurred as a result of the performance of the contract.
2. The roofing contractor shall remove all debris from the job site in a timely and legally acceptable manner so as to not detract from the aesthetics or the functions of the building.

- D. Security:

Obey the owner's requirements for personnel identification, inspection and other security measures.

1.09 JOB SITE PROTECTION

- A. The roofing contractor shall adequately protect building, paved areas, service drives, lawn, shrubs, trees, etc. from damage while performing the required work. Provide canvas, boards and sheet metal (properly secured) as necessary for protection and remove protection material at completion. The contractor shall repair or be responsible for costs to repair all property damaged during the roofing application.
- B. During the roofing contractor's performance of the work, the building owner will continue to occupy the existing building. The contractor shall take precautions to prevent the spread of dust and debris, particularly where such material may sift into the building. The roofing contractor shall provide labor and materials to construct, maintain and remove necessary temporary enclosures to prevent dust or debris in the construction area(s) from entering the remainder of the building.
- C. Do not overload any portion of the building, either by use of or placement of equipment, storage of debris, or storage of materials.
- D. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.
- E. Take precautions to prevent drains from clogging during the roofing application. Remove debris at the completion of each day's work and clean drains, if required. At completion, test drains to ensure the system is free running and drains are watertight. Remove strainers and plug drains in areas where work is in progress. Install flags or other telltales on plugs. Remove plugs each night and screen drain.
- F. Store moisture susceptible materials above ground and protect with waterproof coverings.
- G. Remove all traces of piled bulk materials and return the job site to its original condition upon completion of the work.

1.10 SAFETY

The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state and federal requirements that are safety related. Safety shall be the responsibility of the roofing contractor. All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers and the occurrence of the general public on or near the site.

1.11 WORKMANSHIP

- A. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.
- B. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.
- C. There shall be a supervisor on the job site at all times while work is in progress.

1.12 QUALITY ASSURANCE

- A. The Membrane Roofing System must achieve a UL Class A, B or C as required by State and local Fire Codes.
- B. The specified roofing assembly must have been successfully tested by a qualified testing agency to resist the design uplift pressures calculated according to ANSI/SPRI WD-1 "Wind Design Standard Practice for Roofing Assemblies" American Society of Civil Engineers (ASCE 7) International Building Code (IBC).
- C. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.
- D. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least ten (10) years successful experience installing single-ply membrane roofing systems and having installed at least five (5) roofing application or several similar systems of equal or greater size within one year.
- E. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced superintendent on the job at all times roofing work is in progress.
- F. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the specifier's consideration.
- G. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.

1.13 JOB CONDITIONS, CAUTIONS AND WARNINGS

- A. Safety Data Sheets (SDS) must be on location at all times during the transportation, storage and application of materials.
- B. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.
- C. When loading materials onto the roof, the Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.
- D. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

- E. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.
- F. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.
- G. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.
- H. New roofing shall be complete and weathertight at the end of the work day.
- I. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.14 WARRANTY

- A. Provide manufacturer's 20 year Total System Warranty covering both labor and material with no dollar limitation. The maximum wind speed coverage shall be peak gusts of 90 mph, and as required by the 2015 Michigan Building Code. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.
- B. Pro-rated System Warranties shall not be accepted.
- C. Evidence of the manufacturer's warranty reserve shall be included as part of the project submittals for the specifier's approval.

PART 2 PRODUCTS

2.01 GENERAL

- A. All components of the specified roofing system shall be products of Carlisle SynTec or accepted by Carlisle SynTec as compatible.
- B. All products (including insulation, fasteners, fastening plates and edgings) must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.
- C. Manufacturers:
 - 1. Carlisle
 - 2. Duralast
 - 3. Sika Sarnafil
 - 4. Contact Engineer, for pre-approval of other roof products.

2.02 MEMBRANE

- A. Furnish Sure-Weld white, gray, tan or Special Color FleeceBACK 115-mil reinforced TPO (Thermoplastic Polyolefin) membrane. Membrane thickness over the reinforcing scrim (top-

ply thickness) shall be nominal .015-mil or thicker. Color shall be selected by Owner.

2.03 INSULATION/UNDERLAYMENT

- A. When applicable, insulation shall be installed in multiple layers. The first and second layer of insulation shall be mechanically fastened to the substrate in accordance with the manufacturer's published specifications.
- B. Underlayment types used shall meet requirements of one of the following:
 - 1. DensDeck Cover Board –gypsum core that incorporates glass-mat facings on the top and bottom side for use as a cover board. Available in ¼” to 5/8” and 4’ x 4’ or 4’ x 8’ size boards.

2.04 ADHESIVES AND CLEANERS

All products shall be furnished by Carlisle and specifically formulated for the intended purpose.

- A. Flexible FAST Adhesive: An elongating impact resistant two component insulating urethane adhesive used to attach insulation and FleeceBACK membrane. Packaging formats include 50 and 15 gallon drums as well as Dual Tanks, Dual Cartridges and 5 gallon Bag in a Box formats.
 - 1. Adhesive to provide 150% elongation in conjunction with fleece backed membrane – ASTM D412
 - 2. MDI content of Part A material less than 25%
- B. Sure-Weld Bonding Adhesive: A high-strength, synthetic rubber adhesive used for bonding Sure-Weld membrane to various surfaces. The adhesive is applied to both the membrane and the substrate at a coverage rate of approximately 60 square feet per gallon per finished surface (includes coverage on both surfaces).
- C. Low VOC Bonding Adhesive for TPO: This product meets the <250 gpl VOC (volatile organic compound) content requirements of the OTC Model Rule for Single-Ply Roofing Adhesives. A high strength, solvent-based contact adhesive that allows bonding of TPO membrane to various porous and non-porous substrates. Apply at a rate of 60 ft² per gallon finished surface. Available in 5 gallon pails.
- D. Low VOC Bonding Adhesive 1168: This product meets the <250 gpl VOC (volatile organic compound) content requirements of the OTC Model Rule for Single Ply Roofing Adhesives. A high strength, solvent-based contact adhesive the allows bonding of TPO membrane to various porous and non-porous substrates. Apply at a rate of 60 ft² per gallon finished surface. Available in 5-gallon cans. This product complies with southern California counties with additional restrictions on solvents. See Carlisle’s Product Data Sheet for a listing of the counties involved.
- E. CAV-GRIP III Low-VOC Aerosol Contact Adhesive/Primer: a low-VOC, methylene chloride-free adhesive that can be used for a variety of applications including: bonding Sure-Weld membrane to various surfaces, enhancing the bond between Carlisle’s VapAir Seal

725TR and various substrates, priming unexposed asphalt prior to applying Flexible FAST Adhesive and for adhering Sure-Weld/Sure-Flex FleeceBACK and Sure-Weld TPO membrane to vertical walls. Coverage rate is approximately 2,000-2,500 sq. ft. per 40 lb cylinder and 4,000-5,000 sq. ft. per 85 lb cylinder as a primer, in a single-sided application and 750 sq. ft. per 40 lb cylinder and 1,500 sq. ft. per 85 lb cylinder as an adhesive for vertical walls, in a double-sided application.

- F. **Cut-Edge Sealant:** A white or clear colored sealant used to seal cut edges of reinforced Sure-Weld membrane. A coverage rate of approximately 225 - 275 linear feet per squeeze bottle can be achieved when a 1/8" diameter bead is applied.
- G. **Water Cut-Off Mastic:** Used as a mastic to prevent moisture migration at drains, compression terminations and beneath conventional metal edging (at a coverage rate of approximately 10' per tube or 100' per gallon).
- H. **Universal Single-Ply Sealant:** A 100% solids, solvent free, voc free, one part polyether sealant that provides a weather tight seal to a variety of building materials. It is white in color and is used for general caulking such as above termination bars and metal counter flashings and at scuppers.
- I. **Thermoplastic One-Part Pourable Sealer:** A one-part, moisture curing, elastomeric polyether sealant used to fill TPO Molded Pourable Sealant Pockets. Packaged in 4, 2-liter foil pouches inside a reusable plastic bucket. 1 pouch will fill 2 TPO Molded Pourable Sealant Pockets.
- J. **Weathered Membrane Cleaner:** Used to prepare membrane for heat welding that has been exposed to the elements or to remove general construction dirt at an approximate coverage rate of 400 square feet per gallon (one surface).
- K. **TPO Primer:** A solvent-based primer used to prepare the surface of Sure-Weld Membrane prior to application of Pressure-Sensitive Coverstrip and TPO Pressure-Sensitive RUSS.

2.05 FASTENERS AND PLATES

The Contractor shall use one of the following approved fasteners:

- A. **HP-X Fasteners:** A heavy duty #15 threaded fastener with a #3 phillips drive used for membrane or insulation securement into steel, wood plank or minimum 15/32" thick plywood.
- B. **HD 14-10 Concrete Fasteners:** A #14 threaded fastener with a #3 Philips drive used for minimum 3,000 psi concrete decks.
- C. **HP Termination Bar Nailins:** an expansion anchor with stainless steel drive pin used for fastening the Carlisle Termination Bar or Seam Fastening Plates to concrete, brick, or block walls.
- D. **RhinoBond or Isoweld PVC Welding Plate:** A 3" diameter, 0.028" thick, corrosion-resistant steel plate with high solids coating on the top surface. The plate is secured with Carlisle's HP-X Fastener or Purlin Fastener and the membrane is welded to the top surface using the RhinoBond or Isoweld Induction Welding Tool.

2.06 METAL EDGING AND MEMBRANE TERMINATIONS

- A. General: All metal edging s shall be tested and meet ANSI/SPRI ES-1 standards and comply with International Building Code.
- B. SecurEdge 3000: a metal fascia system with a 20 gauge steel retainer bar and .040” or .050” thick aluminum fascia. Metal fascia color shall be as designated by the Owner's Representative.
- C. SecurEdge 2000: a metal fascia system with an extruded aluminum anchor bar and .040” thick aluminum or 24 gauge galvanized steel fascia. Metal fascia color shall be as designated by the Owner's Representative.
- D. SecurEdge 300: a snap-on edge system consisting of a 24 gauge galvanized metal water dam and .050” thick Kynar 500, clear and colored anodized finish or 24 gauge steel, Kynar 500 finish. Metal fascia color shall be as designated by the Owner's Representative.
- E. SecurWeld Drip Edge: 4'x 10' coated metal sheets made from 24 gauge galvanized steel with a minimum .035" thick non-reinforced Sure-Flex laminate. Coordinate color with Owner’s Representative. Sure-Flex membrane can be welded directly to the Sure-Flex Coated Metal in accordance with the manufacturer’s detail.
- F. SecurEdge Coping: incorporates a 20 gauge anchor cleat with 4 pre-slotted holes, a concealed joint cover and 10 foot continuous sections of coping cap; can accommodate minimum 5 “ wide parapet walls. Metal coping cap color shall be as designated by the Owner's Representative.
- G. Termination Bar: a 1” wide and .098” thick extruded aluminum bar pre-punched 6” on center; incorporates a sealant ledge to support Lap Sealant and provide increased stability for membrane terminations.

2.07 OTHER PRODUCTS / TOOLS

- A. SureWeld TPO Contour Rib Profile: Used to obtain the appearance of standing seam metal roofing with the performance of a TPO singl-ply membrane. The Contour Rib Profile measures 1-1/4” tall and 2-1/8” wide, including the welded flanges, while the vertical profile is a substantial 3/8” thick. The profile has a continuous 1/8” diameter alignment hole, for use with fiberglass connecting pins, as well as a 1/8” fiberglass reinforcing cord for added strength.
- B. Metal Flashing, if required, and miscellaneous items needed to fulfill the project requirements

PART 3 EXECUTION

3.01 GENERAL

- A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, jobsite considerations and weather restrictions.

- B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.02 INSULATION PLACEMENT AND ATTACHMENT

- A. Install insulation or membrane underlayment over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch. Stagger joints both horizontally and vertically if multiple layers are provided.
- B. Secure insulation to the substrate with the required Carlisle fasteners and Flexible Fast Adhesive in accordance with manufacturers specifications.

3.03 MEMBRANE PLACEMENT AND BONDING

- A. Position and unroll successive sheets and align to provide a minimum 2 inch overlap (use pre-marked overlap line) along the selvage edge. At end laps (along the width of the sheet), membrane shall be butted together which will be overlaid with 6 inch wide Sure-Weld Reinforced Membrane and hot air welded on all edges.
- B. FleeceBACK Membrane shall be fully adhered to an acceptable substrate with Carlisle Flexible FAST Adhesive. The adhesive is spray applied or extruded to the substrate only and the membrane is rolled into the wet adhesive once it has foamed up and reached string/gel time (approximately 2 minutes). Roll the membrane with a 30" wide, 150 pound weighted segmented steel roller to set the membrane into the adhesive.

Note: Exercise care to prevent overspray onto the membrane. If Flexible FAST Adhesive should contaminate the splice area, immediately (while the adhesive is still in liquid form) clean with Weathered Membrane Cleaner or allow Flexible FAST Adhesive to cure and remove with a paint-type scraper.

- C. Position adjoining sheets to allow a minimum overlap of 2 inches to provide a minimum 1-1/2" hot air weld.
- D. Continue to install adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches and complete the bonding procedures as stated previously.

3.04 MEMBRANE HOT AIR WELDING PROCEDURES

General

The FleeceBACK membrane has a selvage edge (the fleece-backing is discontinued) along the length of the sheet for membrane splicing. Selvage edges are not provided along the width of the membrane; adjoining membrane sheets must be butted together and overlaid with 6 inch wide Sure-Weld Reinforced membrane heat welded on all sides.

- B. Hot Air Welding Procedures
 - 1. Hot air weld the Sure-Weld FleeceBACK membrane using an Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's specifications. At all splice intersections, roll the seam with a silicone roller to ensure a continuous hot air welded seam.

Note: When using 115-mil thick or thicker membrane, all splice intersections shall be overlaid with Sure-Weld T-Joint covers or non-reinforced flashing

2. Probe all seams once the hot air welds have thoroughly cooled (approximately 30 minutes).
3. Repair all seam deficiencies the same day they are discovered.
4. Apply Cut Edge Sealant on all cut edges of reinforced membrane (where the scrim reinforcement is exposed) after seam probing is complete. Cut Edge Sealant is not required on vertical splices.

3.05 FLASHING

- A. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using Sure-Weld FleeceBack membrane or Sure-Weld reinforced membrane. Sure-Weld non-reinforced membrane can be used for flashing pipe penetrations, scuppers, as well as inside and outside corners when the use of pre-fabricated accessories is not feasible.
- B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.
- C. Sure-Weld Contour Rib Profile Installation:
 1. The Sure-Weld Contour Rib Profiles should be positioned parallel to the laps of the installed TPO roofing system and parallel with the roof slope where possible.
 2. Ensure that all welding surfaces are clean and dry. Inspect all seam areas for proper weld prior to installation.
 3. Set spacing according to project drawings.
 4. Connecting multiple ribs is achieved by using fiberglass pins. Insert a pin half-way into the end of one profile. Connect the adjoining rib by inserting the exposed end of the pin into the alignment hole. Repeat previous steps for additional TPO Contour Rib profiles.
 5. Consult the Sure-Weld Contour Rib Profile installation guides for instructions on proper welding installation techniques.

3.06 DAILY SEAL

- A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.
- B. Use Flexible Fast Adhesive or other similar material in accordance with the manufacturer's requirements.

3.07 CLEAN UP

- A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.
- B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

END OF SECTION

SECTION 07 61 00

PREFORMED METAL FASCIA AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers the furnishing of all labor, materials, tools and equipment required to clean, repair and/or replace all fascia, and required trim pieces as herein specified and/or as required for a complete job.
- B. Submittals: Contractor is to submit samples of stock and field fabricated trim sections to be used on this project for Owner's review. Color samples are to be submitted on actual material for all siding and accessories to be used. Manufacturer's brochures or photocopies will not be considered for review.

1.2 REFERENCES

- A. AAMA 1402-86 Standard Specifications for Aluminum Soffit and Fascia.
- B. ASTM E 84-06 Flame Spread and Smoke Development.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Materials shall be made of 3105-type aluminum sheet with a minimum tensile strength of 29,000 psi. Materials shall be prefinished in manufacturer's standard colors as selected by the Owner from samples submitted by the Contractor.
- B. Fascia: Prefinished aluminum fascia, height as drawings show, min. 0.024" with at least 2 stiffener ribs.
- C. Soffit: Not used.
- D. Siding Accessories: Prefinished aluminum channels, edges and trim sections compatible

with the soffit and fascia systems and as required for a complete installation. Thickness shall be a min. of 0.019". Color to match adjacent material.

- E. Field Fabricated Trim: Trim shall be fabricated from 0.019" prefinished aluminum Trim Sheet.

PART 3 EXECUTION

3.1 CLEANING

- A. Clean all exterior finishes and trim which are scheduled to remain. Use stiff brushes and clear water. Detergents may be used provided no damage results to existing finishes or adjacent materials or plantings. Exercise extreme caution to prevent scratches, dents or other damage to surfaces (including sealants) being cleaned.

3.2 INSTALLATION

- A. All materials in this section to be installed in accordance with manufacturer's instructions.
- B. Care must be exercised in placing aluminum in contact with metals or materials not compatible with aluminum. Dissimilar materials shall be painted or otherwise protected when they are in contact with aluminum or when drainage from them passes over aluminum.
- C. Fasteners shall be of a type which is compatible with material being applied and shall be concealed where possible. Any fasteners which cannot be concealed shall be colored to match material.
- D. Any fascia and/or trim sections observed to be buckling, bowing or "oil canning" will be considered as unacceptable construction and the Contractor will be required to remove and replace these sections at no additional cost. Provide stiffener ribs and/or expansion slots and/or predrill holes at fasteners in field fabricated trims to prevent bowing, buckling or "oil canning".
- E. Provide horizontal blocking at fixture and equipment fastening points. Fasten from back side of wall through blocking, sheathing and plywood blocking.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING, TRIM AND PREFABRICATED ROOF SPECIALTIES

1. PART 1 GENERAL

1.1 WORK INCLUDED

- A. Roof and thru wall flashings.
- B. Metal Coping/Cap Flashing Systems.

1.2 RELATED WORK

- A. Section 074000 - Metal Roofing and Accessories.
- B. Section 076526 - Sheet Membrane Roofing.
- C. Section 079000 - Joint Protection.

1.3 REFERENCES

- A. ASTM B370 - Copper Sheet and Strip for Building Construction.
- B. CDA (Copper Development Association) - Contemporary Copper, A Handbook of Sheet Copper Fundamentals, Design, Details and Specifications.
- C. FS SS-C-153 - Cement, Bituminous, Plastic.
- D. SMACNA - Architectural Sheet Metal Manual.

1.4 SYSTEM DESCRIPTION

- A. Work of this Section is to physically protect wall system from damage that would permit water leakage to building interior.

1.5 QUALITY ASSURANCE

- A. Applicator: Company specializing in sheet metal flashing work with 5 years minimum experience.

1.6 SUBMITTALS

- A. Submit shop drawings and product data.
- B. Describe material profile, jointing pattern, jointing details, fastening methods, and installation details.
- C. Provide product data on shape of components, materials and finishes, anchor types and locations.

1.7 STORAGE AND HANDLING

- A. Store products per manufacturer's recommendations.
- B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.
- C. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

2. PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Copper fabric flashing soft temper; 5 oz/sq ft bonded to and between two layers of asphalt impregnated cotton fabric by means of an asphalt mastic.

2.2 METAL COPING/CAP FLASHING SYSTEM

- A. Fabricated from Aluminum minimum .063" thickness with a Kynar 500 coated finish. System shall include gutter splice plates at the joints to prevent field sealants and insure a weather tight joint. Provide a hold down cleat system with a 16 gauge metal spring clip for proper engagement of coping system.
- B. Accessories:
 - 1. Corners: All aluminum corners are to be welded.
 - 2. Extenders and End Caps: Fabricate from the same material as the Kynar 500 sheet metal.
 - 3. Fluorocarbon Coating: Color as selected from manufacturer's standard color chart. Inhibitive thermo-cured primer, minimum 0.3 mil dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500 or Hylar 5000 resin, minimum 1.0 dry film thickness.
 - 4. Fasteners: Furnish anchors and fasteners, and washers required for a complete and finished installation. Fasteners shall conform with the following requirements: Nails shall be stainless steel, hard copper, bronze, or brass. Where sheet metal is built in over roofing materials or other sheet metal, use nails or screws with 1 inch matching nonferrous washers. Screws shall be standard stainless steel, brass, or bronze wood screws, as required. Sheet metal screws shall be self-drilling, self-tapping stainless steel or tempered non-corrodible steel of proper size and length to suit conditions. Screw heads shall be furnished with neoprene washers.
 - 5. Finish: Fluorocarbon Coating: Color as selected from manufacturer's standard color chart. Inhibitive thermo-cured primer, minimum 0.3 mil dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500 or Hylar 5000 resin, minimum 1.0 dry film thickness.

2.3 ACCESSORIES

- A. Sealant: As specified in Section 079000 - Joint Sealers.

- B. Flashing Cement: FS SS-C-153, Type I-asphaltic base cement.

2.4 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest practical lengths.

3. PART 3 EXECUTION

3.1 INSPECTION

- A. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Conform to drawing details for cavity wall included in SMACNA manual.
- B. On horizontal surfaces flashing to be laid either in a fresh bed of mortar above and below or a trowel coat of mastic. Vertical surfaces shall be spotted with asphalt mastic to hold flashing in place.
- C. Heads and Sills: Flashing shall start 1/2 inch from outside face of wall, then thru the wall turning up at the inside not less than 2 inches and extend 6 inches on each side of the opening. It shall be turned at the ends forming a 2 inch deep pan running entirely thru the wall.
- D. Thru Wall: Flashing shall start 1/2 inch from the outside face of wall, then go thru wall turning up at the inside not less than 2 inches.
- E. Coping: Flashing shall be laid in a fresh bed of mortar above and below and shall come within 1/2 inch of the faces of the wall.
- F. Metal Coping/Cap Flashing: Install per manufacturer's recommendations.
- G. Joints: The material shall be lapped at least 4 inches and cemented with an asphalt mastic.

END OF SECTION

SECTION 07 65 26

SELF-ADHERING SHEET MEMBRANE FLASHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Application of self-adhering sheet membrane flashing.

1.02 RELATED SECTIONS

- A. Section 04 05 23.16 – Masonry Embedded Flashing.
- B. Section 07 21 00 – Thermal Insulation.
- D. Section 07 62 00 – Sheet Metal Flashing, Trim and Prefabricated Roof Specialties.
- F. Section 08 10 00 – Doors and Frames.
- G. Section 08 50 00 – Windows.

1.03 REFERENCES

- A. ASTM D 412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- B. ASTM D 570 – Standard Test Method for Water Absorption of Plastics.
- C. ASTM D 882 – Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
- D. ASTM D 903 – Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
- E. ASTM D 1000 – Standard Test Methods for Pressure-Sensitive, Adhesive-Coated Tapes used for Electrical and Electronic Applications.
- F. ASTM D 1876 – Standard Test Method for Peel Resistance of Adhesives
- G. ASTM E 96 (Method B) – Standard Test Method for Water Vapor Transmission of Materials.
- H. ASTM E 154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- I. ASTM E 2357– Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.04 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittal Procedures.
- B. Submit manufacturer's product data and application instructions.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Use an experienced applicator and adequate number of skilled personnel who are thoroughly trained and experienced in the application of self-adhesive membranes.
- B. Materials: Provide self-adhesive flashing membrane materials which are the products of a single manufacturer.
- C. Pre-Application Conference: A pre-application conference shall be held to establish procedures and to review conditions, installation procedures and coordination with other related work. Meeting agenda shall include review of special details and flashing.
- D. Manufacturer's Representative: Arrange to have trained representative of the manufacturer on-site periodically to review installation procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Store at temperatures at or above 40°F (5°C) free from contact with cold or frozen surfaces.
- D. Store membrane cartons on pallets.
- E. Do not store at temperatures above 90°F (32°C) for extended periods.
- F. Keep away from sparks and flames.
- G. Completely cover when stored outside. Protect from rain.
- H. Protect materials during handling and application to prevent damage or contamination.
- I. Avoid use of products which contain tars, solvents, pitches, polysulfide polymers, or PVC materials that may come into contact with the flashing membrane system.

1.07 PROJECT CONDITIONS

- A. Proceed with installation only when substrate construction and preparation work is complete. If necessary, ensure that subsoil is approved by architect or geotechnical firm.
- B. Warn personnel against breathing of vapors and contact with skin and eyes; wear appropriate protective clothing and respiratory equipment.
- C. Keep flammable products away from spark or flame. Post "No Smoking" signs. Do not allow use of spark-producing equipment during application and until all vapors have dissipated.
- D. Maintain work area in a neat and workmanlike condition. Remove empty cartons and rubbish from the site daily.
- E. Perform work only when existing and forecasted weather conditions are within the limits established by the membrane manufacturer. Do not apply flashing if the temperature is below 40°F (5°C); or to a damp, frost-covered, or otherwise contaminated surface.

1.08 WARRANTY

- A. Manufacturer warrants only that this product is free of defects, since many factors which affect the results obtained from this product are beyond our control; such as weather,

workmanship, equipment utilized and prior condition of the substrate. We will replace, at no charge, proven defective product within twelve (12) months of purchase, provided it has been applied in accordance with our written directions for uses we recommended as suitable for this product. Proof of purchase must be provided. A five (5) year material or system warranty may be available upon request. Contact Polyguard Products, Inc. for further details.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Polyguard Products Inc. P.O. Box 755 Ennis, TX 75120-0755; Phone: (214) 515-5000
Fax: (972) 875-9425 E-mail: info@polyguard.com
- B. Substitutions: As specified in Section 016000 - Product Requirements

2.02 MATERIALS

- A. Polyguard® 400 Flashing is a 40-mil, laminated, modified-asphalt, self-adhesive flashing membrane bonded to a cross-laminated polyethylene sheet.

PHYSICAL PROPERTIES

PROPERTY	TEST METHOD	TYPICAL VALUE
MEMBRANE THICKNESS	ASTM D 1000	40 Mils
SERVICE TEMPERATURE	-	-40°F to 160°F (-40°C to 71°C)
TENSILE STRENGTH - MEMBRANE	ASTM D 412 Modified Die C	675 PSI
TENSILE STRENGTH - FILM	ASTM D 882 Modified	6530 PSI
ELONGATION – ULTIMATE FAILURE OF RUBBERIZED ASPHALT	ASTM D 412 Modified Die C	200%
PERMEANCE TO WATER VAPOR TRANSMISSION	ASTM E 96 Method B	0.04 Perms
PUNCTURE RESISTANCE - MEMBRANE	ASTM E 154	63.4 lbf
PUNCTURE RESISTANCE -FILM	ASTM E 154	42.8 lbf
PEEL ADHESION	ASTM D 903	12.1 lbs/in. width
LAP PEEL ADHESION	ASTM D 1876	8.96 lbs/in. width
AIR PERMEANCE OF AN ASSEMBLY	ASTM E 2357	0.0008cfm/ft2@ 1.57 psf
WATER ABSORPTION	ASTM D 570	0.1%

- 1. Widths with Slit Release Film (SRF) [6], [9], [12], [18]-inches.

2.03 ACCESSORIES

- A. Surface Primer Roller-grade Adhesive:
 - 1. Polyguard® 650 LT Liquid Adhesive: A rubber-based, tacky adhesive which is specifically formulated to provide excellent adhesion.
 - 2. Polyguard® California Sealant: A rubber-based sealant which is specifically formulated to provide excellent adhesion. The VOC (Volatile Organic Compound) content meets the South Coast Air Quality Management District regulations established under the February 1, 1991 version of Rule 1168 ©) (2) Adhesion and Sealant Applications. California Sealant is classified as an Architectural Sealant Primer Porous, with VOC of 527 g/L. Current SCAQMD regulations for this type sealant primer are 775 g/L.
 - 3. Polyguard® Shur-Tac Liquid Adhesive: A polymer emulsion based adhesive which is specifically formulated to provide excellent adhesion.

- B. Edge Termination:
 - 1. Polyguard® Detail Sealant PW™: A single-component, STPE, 100% solid moisture-cured, elastomeric sealant. It is an environmentally friendly, non-isocyanate product that replaces silicone and urethane sealants. It is a low VOC / HAPS-free, cold-applied, self-adhesive, elastomeric sealant.
 - 2. Polyguard® LM-95: A two-component, asphalt-modified, urethane material.
- C. End Dams and Corners:
 - 1. The Polyguard® Preformed Inside Corner Flashing and End Dams are a 40-mil combination of rubberized asphalt bonded to a cross laminated polyethylene film. The adhesive surface is covered with a release liner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Protect adjacent surfaces not designated to receive self-adhering flashing membrane.
- B. Clean surfaces to receive membrane in accordance with manufacturer's instructions.
- C. Do not apply membrane to surfaces unacceptable to manufacturer.
- D. All surfaces must be clean, smooth, dry; and clean of oil, dust, and excess mortar.
- E. Flashing requires support across gaps and openings greater than 1/8-inch. Modify any 90 degree intersections, i.e. between walls and ledges, to have a sloped transition from the vertical-to-horizontal plane.
- F. On all overlaps, install at a minimum of a 2 1/2-inch side lap and 6-inch end lap.

2.03 APPLICATION

- A. Apply a coating of Polyguard® 650 LT Liquid Adhesive, California Sealant, or Shur-Tac Liquid Adhesive at a rate of 250-300 square feet per gallon, or selected Spray Adhesive; and allow the adhesive to dry to the touch before covering with associated accessories. Do not thin Liquid Adhesive. If a substrate has been coated with Polyguard® Airlok Flex®, Airlok Flex® VP, Airlok Flex® VP LT, Airlok Flex® WG, or Airlok Flex® WG LT; and the coating is cured, priming with a liquid adhesive is not necessary.
- B. Install Polyguard® 400 Flashing in ambient and substrate surface temperature of 40°F (5°C) and rising. Conduct a field adhesion test at temperatures below 40°F (5°C) prior to application.
- C. Apply pressure over the face of the installed membrane with a hard surfaced rubber roller or similar blunt instrument.
- D. Terminate the top edge of flashing with Polyguard® Detail Sealant PW™. Termination Bar is recommended.

3.04 PROTECTION

- A. 400 Flashing can be left exposed to UV for up to thirty (30) days.
- B. Cover the membrane when applicable in a manner that prevents damage to the material.

END OF SECTION

SECTION 07 90 00

JOINT PROTECTION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section includes furnishing all labor and materials required to caulk around the entire perimeter of all door and window frames, interior control joints and where wood, metal, masonry and concrete meet. Do all other caulking necessary to complete the work as herein specified. Include caulking at plumbing fixtures and fittings.
- B. Job Requirements: Sealant and caulking color to be selected by Owner from manufacturer's standards.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Caulking Compound (heated interior spaces): Shall be acrylic base, gun grade, non-staining, high elastic recovery, waterproof and paintable material. Shall be Pecora AC-20, "Externalflex Acrylic Latex" by Gibson Homes, "Acrylic Latex Caulk" by Dow Corning, "Acrylic Latex Caulk" by Tremco or Owner approved equal.
- B. Sealant (interior areas exposed to moisture): One-part silicone sealant "786 Mildew Resistant" by Dow Corning or Owner approved equal.
- C. Exterior sealant shall be "Dowsil 795 Sealant" by Dow, "Silicone Sealant 1200" by General Electric, "862 Architectural Silicone Sealant" by Pecora or Owner approved equal.
- D. Primers: As recommended by caulking and sealant manufacturers.
- E. Joint Back-Up Materials: Preformed rod or tube shaped of flexible, non-extruding, closed cell polyurethane, polyethylene, polystyrene or butyl of the non-adhering type, free from oil, tar, bitumen, solvents or other non-compatible foreign materials. Back-up material shall conform to Federal Specification HH-F-34ld, latest edition.
- F. Wall and Floor Penetration Sealant (Interior): Shall be 3M Fire Barrier 2000 Silicone Sealant or Owner approved equal.

3. PART 3 EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. All surfaces to receive caulking or sealant shall be clean, dry and free from all oils, grease, wax, tar, and other foreign materials. Temperature and other related conditions shall be per manufacturer's recommendations.
- B. Materials shall be applied with a pressure gun (knife where necessary) in a neat, thorough and workmanlike manner by experienced mechanics. Neatly tool finish all joints flush with surface and point internal corners with coving tool. Remove excess materials and clean adjacent surfaces.
- C. All electrical, mechanical and plumbing penetrations through walls and floors are to be filled with sealant to prevent access by rodents and insects. Install escutcheons and wall plates to trim out penetrations.
- D. Seal all cracks, joints, edges, etc. at cabinetry to prevent nesting or migration of rodents and insects.

END OF SECTION

SECTION 08 10 00

METAL DOORS AND FRAMES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush Steel Doors.
- B. Steel Frames.
- C. All openings shall be verified in the field by Contractor before fabrication.
- D. System Requirements: The door system components shall be manufactured by one company. Substitutions using a multi source system will not be considered.

1.2 RELATED SECTIONS

- A. Section 04 20 00 - Unit Masonry.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 07 90 00 - Joint Protection.
- D. Section 08 71 00 - Door Hardware.
- E. Section 08 80 00 - Glazing: Glass for doors.
- F. Section 09 25 00 - Gypsum Drywall.

1.3 REFERENCES

- A. ANSI/DHI A 115.1G – Installation Guide for Doors and Hardware.
- B. ANSI/BHMA A 156 – Specifications for Hardware Preparations in Standard Steel Doors and Frames.
- C. ANSI A 250.11 – Recommended Erection Instructions for Steel Frames.

1.4 SUBMITTALS

- A. Submit under provision of Section 01 33 00.
- B. Product Data: Manufacturer's standard details and catalog data indicating compliance with referenced standards, and manufacturer's installation instructions.
- C. Shop Drawings: Door, frame, and hardware schedule in accordance with SDI 111D. Show types, quantities, dimensions, specified performance, and design

criteria, materials and similar data for each opening required.

1. Indicate frame configuration, anchor types and spacing, location of cutouts for hardware, reinforcement, to ensure doors and frames are properly prepared and coordinated to receive hardware.
2. Indicate door elevations, internal reinforcement, closure method, and cutouts for glass lights and louvers.

1.5 QUALITY ASSURANCE

- A. Supplier: A direct account of the manufacturer who has on permanent staff, an Architectural Hardware Consultant, a Certified Door Consultant or an Architectural Openings Consultant, who will be available to consult with the Architect and Contractor regarding matters affecting the door and frame openings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle, store and protect products in accordance with the manufacturer's printed instructions and ANSI/SDI A250.10 and NAAMM/HMMA 840.
- B. Store doors vertically in a dry area, under a proper vented cover. Place on 4 inch high wood sills to prevent rust or damage. Provide ¼-inch space between doors to promote air circulation.
- C. Store frames in an upright position with heads uppermost under cover. Place on 4 inch high wood sills to prevent rust or damage. Store assembled frames five units maximum in a stack with 2 inch space between frames to promote air circulation.
- D. Do not use non-vented plastic or canvas shelters to prevent rust or damage.
- E. Should wrappers become wet, remove immediately.

1.7 COORDINATION

- A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal cutouts and reinforcement for door hardware, electric devices and recessed items.
- B. Coordinate Work with frame opening, door and hardware installation.
- C. Sequence installation to accommodate required door hardware.
- D. Verify field dimensions for factory assembled frames prior to fabrication.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Acceptable Manufacturer: Steelcraft, Div. of IR Security Technologies, which is located at : 9017 Blue Ash Road; Cincinnati, OH 45242; Toll Free Tel.: 800-

243-9780.

- B. Substitutions will be considered in accordance with the provisions of Section 012500.
- C. Provide all steel doors and frames from a single manufacturer.

2.2 DOORS

- A. General: Construct doors to the following designs and gauges:
 - 1. Doors: Zinc-Iron Alloy-Coated galvanized steel, ASTM A 653, Class A60:
 - a. Thickness: 18 gauge.
 - b. Include galvanized components and internal reinforcements with galvanized doors.
 - c. Close tops of exterior swing-out doors to eliminate moisture penetration. Galvanized steel top caps are permitted.
 - 2. Include galvanized components and internal reinforcements.
 - 3. Prime Finish Doors: Clean, phosphatize and factory prime painted doors indicated on Door Schedule as HM.
 - 4. Hardware Reinforcements:
 - a. Hinge reinforcements for full continuous hinges: minimum 7 gauge.
 - b. Lock reinforcements: minimum 16 gauge.
 - c. Closer reinforcements: minimum 14 gauge steel, 20-inch long.
 - d. Galvanized doors: include galvanized hardware reinforcements.
 - e. Projection welded hinge and lock reinforcements to the edge of the door.
 - f. Provide adequate reinforcements for other hardware as required.

- B. Full Flush Doors:
 - 1. Acceptable Product: Steelcraft L Series.
 - a. Performance:
 - 1) Physical performance: 5 million cycles per ANSI
 - 2) Thermal performance (gasketed), ASTM C1363.
 - a) Polyurethane core, 0.498 U-factor.
 - 3) Thermal performance (gasketed), ASTM C236.
 - a) Polyurethane core, 0.09 U-factor.
 - 2. Door Thickness: 1-3/4 inches(45 mm).
 - 3. Door faces reinforced and sound deadened as follows:
 - a. Polyurethane Core (exterior only): Full 1-3/4 inches thick rigid polyurethane, adhered to inside of door faces and polyurethane core with waterproof adhesive for bond strength and rust prevention. Use a cardboard honeycomb core for interior doors.
 - 4. Vertical edge seams: Provide doors with continuous vertical mechanical interlocking joints at lock and hinge edges. Finish edges as follows:
 - a. Welded Vertical Edges (W): Continuous vertical mechanical interlocking joints; edge seams welded, epoxy filled, and ground smooth.

5. Bevel hinge and lock door edges 1/8 inch in 2 inches. Square edges on hinge and/or lock stiles are not acceptable.
6. Reinforce top and bottom of doors with galvanized 14 gauge (1.7 mm), welded to both panels.

2.3 DOOR FRAMES

- A. General: Construct exterior metal door frames to the following designs and gauges:
 1. Exterior Frames: Zinc-Iron Alloy-Coated galvanized steel, ASTM A 653, Class A60:
 - a. Thickness: 14 gauge.
- B. Full Steel Frame:
 1. Acceptable Product: Steelcraft F-Series.
 2. Construction: Three-piece knock-down frames; mitered joints, with locking tab at each head and jamb intersection. Factory-welded frames.
 3. Profile:
 - a. 2 inches (51 mm) face dimension with 5/8 inch high stop.
 4. Provide following reinforcement and accessories:
 - a. Hinge preparation for continuous geared hinges.
 - b. Strike preparation (single doors) for 4-7/8 inch universal strike; with plaster guard.
 - c. Silencers. Prepare frames to receive inserted type door silencers, 3 per strike jamb on single doors. Stick-on silencers are not permitted.
 5. Finish: Factory prime finish in accordance with ANSI A 250.10.

2.4 ACCESSORIES

- A. Anchors: Manufacturer's standard anchors for masonry walls, specified in manufacturer's printed installation instructions for project conditions.
- B. Silencers: Resilient rubber, inserted type, three per strike jamb for single openings. Stick-on silencers shall not be permitted.

2.5 FABRICATION

- A. Steel Frames:
 1. Factory-welded frames: Head and jamb intersecting corners mitered at 45 degrees, with back welded joints ground smooth.
 - a. Continuous face weld the joint between the head and jamb faces along their length either internally or externally. Grind, prime paint, and finish smooth face joints with no visible face seams.
 - b. Externally weld, grind, prime paint, and finish smooth face joints at meeting mullions or between mullions and other frame members per a current copy of ANSI/SDI A250.8.
 - c. Provide two temporary steel spreaders (welded to the jambs at each rabbet of door openings) on welded frames during shipment. Remove temporary steel spreaders prior to installation of the frame.

2.6 FINISHES

- A. Chemical Treatment: Treat steel surfaces to promote paint adhesion.
- B. Factory Prime Finish: Meet requirements of ANSI A 250.10.

3. PART 3 EXECUTION

3.1 ERECTION

- A. Install doors in accordance with ANSI A250.8.
- B. All items shall be set in their correct locations and shall be level, square, plumb, at proper elevations and in alignment with existing conditions.
- C. All joints shall be tightly caulked in order to secure a watertight job. All materials shall be screwed in place using backing, masonry plugs, and/or anchor straps as required.
- D. Where jamb pieces are joined, they shall be accurately cut and fitted to result in a tightly closed joint.
- E. Coordinate installation of glass and glazing specified in Section 08 80 00.
- F. After erection, the Contractor shall adequately protect exposed elements from damage.

3.2 ADJUST AND CLEAN

- A. Adjust doors for proper operation, free from binding or other defects.
- B. Clean and restore soiled surfaces. Remove scraps and debris and leave site in a clean condition.
- C. Prime Coat Touch-Up: Immediately after erection, sand smooth rusted or damaged areas of prime coat, and apply touch-up of compatible air-drying primer.

END OF SECTION

SECTION 08 51 13

ALUMINUM WINDOWS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of Extruded aluminum windows.
 - 1. Windows and accessories to be furnished and install under this contract.
- B. Factory glazing.

1.2 REFERENCES

- A. AAMA/NWWDA 101/I.S.2 – Voluntary Specifications for Aluminum, Vinyl (PVC) and wood windows and glass doors; American Architectural Manufacturers Association; 1997 with revisions contained in “reprinting” of 12/99.
- B. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 1998.
- C. AAMA CW-10 – Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 1997.
- D. ASCE 7 – Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 1998 (Pub. 2000).
- E. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2001.
- F. ASTM B 221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2000.
- G. ASTM E 283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 1991 (Reapproved 1999).
- H. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and doors by Uniform Static air Pressure Difference; 1997.
- I. ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference: 2000.

- J. ASTM E 1105 – Standard Test Method for Field Determination of Water Penetration of installed Exterior windows, skylights, doors and curtain walls, by Uniform or Cyclic Static Air Pressure Difference; 2000.
- K. FS L-S-125 – Screening, Insect, Non-metallic; Federal Specification and Standards; Revision B, 1972.
- L. SSPC-Paint 20 – Zinc-Rich Primers (Type I, “inorganic, and Type II, “organic”); Society for Protective coatings; 1982 (Ed. 2000).
- M. SSPC-Paint 25.1 – Zinc Oxide, Alkyd, Linseed Oil Primer for use over hand cleaned steel; Society for Protective coatings; 1997. (ed. 2000).

1.3 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: As specified in Part 2, with the following additional requirements:
- B. Design and size windows to withstand the following load requirements, when tested in accordance with ASTM E 330 using test loads equal to 1.5 times the design wind loads with 10 second duration of maximum load:
 - 1. Design Wind Loads: Comply with requirements of ASCE 7.
 - 2. Member Deflection: Limit member deflection to flexure limit of glass in any direction with full recovery of glazing materials.
- C. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- D. Air Infiltration: Limit air infiltration through assembly to 0.1 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E 283, D.2 cu/ft/min/sq ft. for DH slider.
- E. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 12 lbf/sq ft.
- F. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, or migrating moisture occurring within system.
- G. Window system shall not promote condensation between the glass surfaces.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.
 - 1. Provide complete field measurements to verify proper fit of windows and accessories.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of AAMA 101 Designation AW60.
- B. Manufacturer: company specializing in fabrication of commercial aluminum windows of types required, with not fewer than five years of experience.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install sealants when ambient temperature is less than 40° degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.8 WARRANTY

- A. See Section 01 70 00 – Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a 10-year period after date of substantial completion.
- C. Provide 10-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide 10-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
- E. Provide warranty direct to Owner with all parts and labor included and no prorating for depreciation and may not be a pass through.

2. PART 2 PRODUCTS

2.1 MANUFACTURES

- A. Wausau Window and Wall Systems: 4250i-XLT INvent Series, Projected and Fixed.
- B. Or as approved by Architect.

2.2 MATERIALS

- A. Aluminum Framing Members
 - 1. Extruded aluminum billet, 6063-T5 or T6 alloy for primary components; 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for structural components; all meeting the requirements of ASTM B221.
 - 2. Aluminum sheet alloy 5005-H32 (for anodic finishing), or alloy 3003-H14 (for painted or unfinished sheet) meeting the requirements of ASTM B209.
 - 3. Principal extruded framing members shall be a minimum 0.090" in thickness.
 - 4. Extruded or formed trim components will be a minimum 0.060" in thickness.
 - 5. System (frame) depth 4-7/8" with standard 1" glass setback. Primary mullion split tube depth 2-1/2".

2.3 COMPONENTS

- A. Sealants:
 - 1. All sealants shall comply with applicable provisions of AAMA 800 and/or Federal Specifications FS-TT-001 and 002 Series.
 - 2. Frame joinery sealants shall be suitable for application specified and as tested and approved by window manufacturer.
- B. Glass:
 - 1. Provide in accordance with Section 08 80 00.
 - 2. Sealed insulated glass shall be tested and certified in accord with ASTM E2190.
- C. Glazing:
 - 1. Provide in accordance with Section 08 80 00.
 - 2. Glazing method shall be in general accordance with the GANA Glazing Manual for specified glass type, or as approved by the glass fabricator.
 - 3. Provide windows factory-glazed wherever practical.

2.4 FABRICATION

- A. Fabricated components with smallest possible clearances and shim spacing around perimeter of assembly that will enable window installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joint and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices.
- D. Arrange fasteners and attachments to ensure concealment from view.
- E. Provide steel internal reinforcement in mullions as required to meet loading requirements.

- F. Provide internal drainage of glazing spaces to exterior through weep holes.
- G. Factory glaze window units.

2.5 FINISHES

- A. Finish of Aluminum Components:
 - 1. Finish of all exposed areas of aluminum windows and components shall be done in accord with the appropriate AAMA Voluntary Guide Specification shown.
 - a. Designation: AAM10C21A41.
 - b. Description: Clear Class I Eco-friendly etch.
 - c. Standard: AAMA 611.
 - d. Color: by Owner.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.
- B. Do not install windows until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install windows in accordance with manufacturer's instructions
- B. Install window assembly in accordance with AAMA 101.
- C. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- D. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- E. Install sill and sill end angles.
- F. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- G. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials.
- H. Install perimeter sealant in accordance with requirements specified in Section 07 90 00.

3.3 ERECTION TOLERANCES

- A. Maximum Variation from Level or Plumb: 1/16 inches every 3 feet non-cumulative or 1/8 inches per 10 feet, whichever is less.

3.4 ADJUSTING AND CLEANING

- A. Removal protective material from factory finished aluminum surfaces
- B. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

SECTION 08 56 19.03
SELF-CLOSING SERVICE WINDOWS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings: Illustrate products, installation, and relationship to adjacent construction.
 2. Product Data: Manufacturer's descriptive data and product attributes.
 3. Samples: [Selection samples.] [Verification samples.]

1.2 WARRANTY

- A. Manufacturer's one year warranty against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Contract Documents are based on products by QuikServ Inc. 11441 Brittmoore Park Drive, Houston, TX 77041, Toll-Free: 800-388-8307, Tel: 713-849-5882, Fax: 713-849-5708, www.quikserv.com, email: sales@quikserv.com.
- B. Substitutions: [Refer to Division 01.] [Not permitted.]

2.2 PERFORMANCE REQUIREMENTS

- A. [Ballistics Performance: Installed bullet-resistant glazing shall withstand ballistic impact loads and forces without damage to the glazing beyond that allowed by referenced standards.]

2.3 MANUFACTURED UNITS, GENERAL

- A. Type: Extruded aluminum-framed, horizontal-sliding, manual-opening, self-closing, transaction window unit.
1. Track: Top-hung with no bottom track.
 2. Slides: Stainless steel slide rail, ball bearing type.
 3. Frame Depth: 4-1/2 inches, unless otherwise indicated.

2.4 SELF-CLOSING WINDOWS

- A. Type: Self-closing transaction window unit.
1. Product: [insert Quikserv model]
 2. Functionality: [Single] [Bi-Parting] [Double] [Security]
 3. Finish: [Clear Anodized] [Bronze Anodized] [Steel] [Colored Anodized] [Custom Paint]
 4. Glazing: [Tempered] [Insulated] [Tinted] [Laminated] [Security]

5. Placement: [Flush mount] [Projected]
6. Actual Size (w x h): [insert size].

2.5 SELF-CLOSING, CALIFORNIA-APPROVED WINDOWS

- A. Type: Self-closing transaction window unit with limited size service opening and air curtain to comply with the California Retail Food Code.
 1. Product: Model [insert model]
 2. Actual Size (w x h): [insert size]
 3. Functionality: [Single] [Bi-Parting] [Double] [Security]
 4. Finish: [Clear Anodized] [Bronze Anodized] [Steel] [Colored Anodized] [Custom Paint]
 5. Glazing: [Tempered] [Insulated] [Tinted] [Laminated] [Security]
 6. Service Opening Area: [216 sq in] [432 sq. in.]
 7. Accessories: [Air Curtain] [Panel] [Insect screen]

2.6 HARDWARE

- A. Hardware:
 1. Latch: Manufacturer's standard spring latch with manual pull and thumb release which automatically locks on closing.
 2. [Hook-Lock: Maximum security Adams Rite style hook lock with interior thumb-turn.]
 3. [Night Security Lock Bar: Extruded aluminum bar sized to fit track to prevent sliding sash from moving.]

2.7 ACCESSORIES

- A. Shelf: Stainless steel with folded edges[, complete with matching shroud].
 1. Shelf Size: [insert dimensions].
- B. Air Curtain: ETL listed high volume, high velocity air stream blower [with built-in heater] designed to mount above window to keep indoor air in and to keep insects, fumes, dust, odors, and other contaminants out.
 1. Performance: Air volume and velocity adjustable with control knob to maximum 645 CFM air volume at 2100 FPM velocity.
 2. [Non-Heated Blower Motor Characteristics: Single phase, 120 V, 3.4 A]
 3. [Relay to sync operation of air curtain with window opening and closing.]
 - a. Product: Model QSK1025AA-BK.]
 4. [Heated Blower Motor Characteristics: Single phase, 208/240 V, 16.1/18.4]
 5. [Relay to sync operation of air curtain with window opening and closing.]
 - a. Product: Model QSV1025EJ-040-BK.]
 6. Finish: Manufacturer's standard powder coating, black color.

2.8 GLAZING

- A. Glass:
 1. Tempered Glass: ASTM C1048; Type I; Quality-Q3; Kind FT; [Class 1 clear.] [Class 2 tinted].
 - a. Tint Color: [_____].
 2. Insulating-Glass Units: Factory-assembled units, qualified according to ASTM E2190.

- a. Outer Lite: 4 mm (5/32 inch) clear fully tempered.
- b. Interstitial Space: 5/16 inch (7.5 mm) air.
- c. Inner Lite: 4 mm (5/32 inch) clear fully tempered.

**** OR ****

3. Bullet Resistant Glazing: Pass UL 752 Level [1] [2] [3]

- d. Level 1 Form: [Laminated polycarbonate/acrylic/polycarbonate] [Acrylic sheet] [Glass-clad polycarbonate per ASTM C1349] [All-Glass]
- e. Level 2 Form: [Laminated polycarbonate/acrylic/polycarbonate] [Acrylic sheet] [Glass-clad polycarbonate per ASTM C1349] [All-Glass]
- f. Level 3 Form: [Laminated multi-ply polycarbonate] [Acrylic sheet] [Glass-clad polycarbonate per ASTM C1349] [All-Glass].

2.9 MATERIALS

- A. Extruded Aluminum: ASTM B 221; alloy and temper recommended by manufacturer for type of use and finish indicated
- B. Stainless Steel: ASTM A240, Type 304.

2.10 FINISHES

- A. Anodized Aluminum Finish: AAMA 611, Architectural Class II anodized, [clear.] [dark bronze.] [____.]

**** OR ****

- B. Pigmented Organic Aluminum Finish: AAMA 2603 thermosetting polyester/epoxy powder coating, [stock color to be selected from manufacturer's full color range.] [custom color as directed.]
- C. Stainless Steel Finish: No. 4 satin brushed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

END OF SECTION

SECTION 08 71 00

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 00 00 00 – Procurement and Contracting Requirements
 2. Division 01 00 00 – General Requirements
 3. Division 06 00 00 – Wood, Plastics, and Composites
 4. Division 08 00 00 – Openings
- 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. 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.

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. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
- j. Typed Copy.
- k. Double-Spacing.
- l. 8-1/2 x 11 inch sheets
- m. 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. 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 Warranties:
- A. Refer to Division 1 for warranty requirements.
 - B. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Replace work found to be defective as defined in the General Conditions.

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. Products of a BHMA member are acceptable.
 - B. Locksets and Latchsets – Mortise Type:
 1. Function as indicated on drawings.
 2. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips that do not project more than 1/8" beyond doorframe trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.
 - C. Push and Pull Hardware:
 1. Push Plates: Ives 8200 Series or equal.
 2. Pull Plates: IR-Ives 8302-8 Series or equal.
 3. Pull, Wire: 3/4 inch diameter, 6 inch centers.

4. Manufacturer: Provide push and pull hardware from any member of B.H.M.A.

D. Closers:

1. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. Cylinder body shall be 1 ½" in diameter, and double heat treated pinion shall be 11/16" in diameter with double D slab drive arm connection.
2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.
4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).
5. All surface mounted mechanical closers shall be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory.
6. Closers will have Powder coating finish certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.
7. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.
8. IR-LCN Series or equal.

E. Bumpers:

1. Wrought, forged, or cast, approximately 2-1/2 inch diameter, convex or concave rubber center, concealed fasteners.
 - a. IR-Ives WS407CCV
 - b. BHMA L02101.

F. Wall Stops:

1. Length to exceed projection of all other hardware. Provide with threaded studs and expansion shields for masonry wall construction.
 - a. IR-Ives WS447
 - b. BHMA L12011 or L12021

G. Thresholds:

1. 1/2" high - 5" wide. 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

H. Door Sweeps:

1. Surface Sweeps:
 - a. National Guard as listed in sets

b. Equal by Zero or Reese

I. 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

J. Miscellaneous:

1. Furnish items not categorized in the above descriptions but specified by manufacturer's names in Hardware Sets.

K. 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. Provide finish for each item as indicated in sets.

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 and/or core for all hardware components capable of being locked.
- D. Provide cylinders master and grand master keyed to existing Yale 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. 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.

<u>CATEGORY</u>	<u>DIMENSION</u>
Hinges	Door Manufacturer's Standard
Levers	Door Manufacturer's Standard
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 adjusted after installation and after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
4. A written report stating compliance, and also recording locations and kinds of noncompliance, shall be sent 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: Refer to "Door Hardware Set" on Architectural drawings.

END OF SECTION

SECTION 08 80 00

GLAZING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass and glazing for doors and windows.

1.2 RELATED SECTIONS

- A. Section 079000 - Joint Protection.
- B. Section 084100 - Aluminum Entrances, Storefronts, and Windows.
- C. Section 085200 - Aluminum Windows.

1.3 REFERENCES

- A. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- B. ASME Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
- C. FS TT-S-01543 - Sealing Compound, Silicone Rubber Base.

1.4 PERFORMANCE REQUIREMENTS

- A. Glass and glazing materials of this Section shall provide continuity of building enclosure vapor and air barrier:
 - 1. In conjunction with materials described in Section 07 90 00 - Joint Protection.
- B. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass to a design pressure of 20 lb./sq. ft. as measured in accordance with ASTM E330.
- C. Limit glass deflection to 1/200 with full recovery of glazing materials, whichever is less.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install glazing when ambient temperature is less than 50°F.

- B. Maintain minimum ambient temperature before, during, and 24 hours after installation of glazing compounds.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

1.8 SEQUENCING, SCHEDULING AND COORDINATION

- A. Coordinate Work under provisions of Section 01 30 00.
- B. Do not install glass or glazing until major construction is complete and building interior is enclosed and heated.

1.9 WARRANTY

- A. Provide 5-year manufacturer's warranty under provisions of Section 01 70 00.

2. PART 2 PRODUCTS

2.1 INSULATING GLASS

- A. Description:
 - 1. Comply with ASTM E2190.
 - 2. Certification: Insulating Glass Certification Council and Insulating Glass Manufacturers Alliance.
 - 3. Total Unit Thickness: 1-inch unless noted otherwise.
 - 4. Unit Edge Seal:
 - a. Type: Silicone sealant.
 - b. Material: Aluminum.
 - c. Corners: Bent and spot welded.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate conditions and that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

3.3 INSTALLATION

- A. Place setting blocks at 1/3 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
- C. Fill gaps between glazing and stops with silicone type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.4 CLEANING

- A. Clean work under provisions of Section 01 70 00.
- B. Remove glazing materials from finished surfaces.
- C. Remove labels after work is complete.
- D. Clean glass.

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 50 00.
- B. After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION

SECTION 09 25 00

GYPSUM DRYWALL

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers furnishing all labor, materials, tools and equipment required to install all gypsum wallboard, metal corner beads, trims and expansion joints, drywall patches and repairs as well as herein specified and/or as required for a complete job.
- B. Cold Weather Requirements: For the day before through the day after the period of laminating and of finishing of wallboard joints, if outside temperatures will be less than 55°, maintain the temperature within the building within the range of 55° to 70° F. Adequate ventilation shall also be provided to eliminate excessive moisture within the building during this same period.
- C. Delivery of Materials: All materials, as specified, shall be delivered to the job in their original unopened containers or bundles, stored in a place providing protection from damage and exposure to the elements.
- D. Subsurface: Examine and inspect materials to which gypsum board is to be applied. Remedy all defects prior to installation of drywall.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Trade names of the United States Gypsum Company have been used to establish the desired quality of materials specified herein. Products meeting these specifications will be allowed as manufactured by Georgia-Pacific, Gold Bond Building Products Division, National Gypsum Co., or Owner approved equal.
- B. Gypsum wallboard shall conform to ASTM C36 "Specification for Gypsum Wallboard" with ASTM C-630 Specification added for Water Resistant Wallboard "W/R".
- C. Gypsum Wallboard at Walls: Shall be 1/2" or 5/8" (per drawings) Sheetrock SW, located as specified herein.
- D. Gypsum Wallboard at Wet Areas (Restrooms): Shall be 1/2" or 5/8" (per drawings) Sheetrock W/R, located as specified herein.
- E. Corner Beads and Metal Trim: Shall be Dur-A-Bead 101 or 200A. Corner reinforcement for adhesive attachment shall be Perf-A-Bead Reinforcement.
- F. Joint Treatment Material: USG "Durabond 90" Joint Compound and USG Ready

Mixed Joint Compound All Purpose.

- G. Special Note: The Sheetrock SW System (Board and Joint Treatment) was tested and designed to function as a unit. Substitution for one and not all of the procedures and/or products in this specification is not recommended.

3. PART 3 EXECUTION

3.1 APPLICATION

- A. The installation and application of all USG materials shall be in accordance with the latest printed directions or specifications of United States Gypsum and as follows:
- B. Gypsum Wallboard: All ends and edges of Sheetrock Gypsum Wallboard shall occur over fastening members, except when joints are at right angles to framing members as in horizontal application. Ceiling wallboard shall be attached to framing supports utilizing both glue and screw fastening.
- C. Sheetrock Gypsum Wallboard shall be applied to minimize end joints. Boards shall be brought into contact, but shall not be forced into place. Where ends or edges abut, they shall be neatly fitted. End joints shall be staggered. Joints on opposite sides of a partition shall be so arranged as to occur on different studs.
- D. Wallboard shall be attached to framing supports with screws; no nailing will be permitted. Fasteners shall provide a slight depression below the surface of the wallboard without breaking the face paper and fasteners shall not be driven closer than 3/8" from edges and ends of the board. While the fasteners are being driven, the wallboard shall be held in firm contact with the underlying support. Attachment should proceed from the center of the wallboard towards ends and edges.
- E. When necessary to cut ends and edges, scribe, or make cutouts within the field of the wallboard, it shall be done in a workmanlike manner.
- F. Metal corner beads shall be securely attached as per manufacturer's recommendations, to all external corners and in single lengths. Clinch and nail corner beads securely.
- G. Metal trim shall be installed where drywall abuts exposed dissimilar wall material in the manner recommended by the manufacturer.

3.2 JOINT TREATMENT

- A. Unless otherwise indicated, all walls, partitions and ceilings are included. Joints of exterior gypsum wallboard, where not exposed to view, shall not be treated, but shall be installed butted tightly.
- B. Mixing - Durabond "90" joint compound shall be mixed according to the directions on the bag. Caution shall be used to prevent excessive mixing and use

of extremely cold water and compound.

- C. All V-grooves formed by abutting wrapped eased edges of Sheetrock SW shall be pre-filled with Durabond "90" joint compound. Application shall be with a flexible 5" or 6" joint finishing knife or an Ames Pre-Fill tool. The V shall be filled flush with the plane of the taper depression and any excess compound beyond the groove shall be wiped clean, leaving a clear depression to receive tape. The pre-fill shall have hardened prior to the next application.

- D. Taping or embedding - USG Ready Mixed Joint Compound - All Purpose, shall be applied with a suitable tool in a thin uniform layer to all joints and angles to be reinforced. Perf-A-Tape reinforcement shall be applied immediately and centered over the joint and seated into the compound. Sufficient compound must remain under the tape to provide proper bond. A skim coat shall immediately follow tape embedment but not to function as a fill or a second coat.
- E. Tape shall be properly folded and embedded in all angles to provide a true angle.
- F. The tape or embedding coat must be thoroughly dry prior to application of the fill coat.
- G. Filling - USG Ready Mixed Compound - All-Purpose, shall be applied over the embedding coat, filling the board taper flush with the surface. On joints with no taper, the fill coat shall cover the tape and feather out at least 4" on either side of the tape. No fill coat is necessary at interior angles.
- H. The fill coat shall be thoroughly dry prior to application of the finish coat.
- I. Finishing - USG Ready Mixed Joint Compound - All Purpose, shall be spread evenly over and extended slightly beyond the fill coat on all joints and feathered to a smooth uniform finish. On tapered joints, the finish coat shall not protrude beyond the plane of the surface.
- J. All taped angles shall receive a finish coat to cover the tape and taping compound, providing a true angle. Where necessary, sanding shall occur between coats and following the final application of compound to provide a smooth surface ready for decoration.
- K. Filling and finishing of fastener depressions - A taping or all-purpose compound must be applied as the first coat to all fastener depressions. This shall be followed by a minimum of 2 additional coats of all-purpose compound, leaving all depressions level with the plane of the surface.

3.3 COMPLETION

- A. Contractor shall correct all poorly installed drywall including, but not limited to, poor seams, "nail pops", poorly executed patches, etc. Final gypsum board condition shall be like new and ready to receive paint.

END OF SECTION

SECTION 09 90 00

PAINTING AND FINISHES

1. PART 1 GENERAL

1.1 WORK INCLUDED

- A. Surface preparation.
- B. Surface finish schedule.
- C. Color selection schedule.
- D. Applying finishes to existing structures and equipment as specified.

1.2 RELATED WORK

- A. Section 042000 - Unit Masonry.
- B. Section 081000 - Metal Doors and Frames.
- C. Section 092500 - Gypsum Drywall.

1.3 REFERENCES

- A. ANSI/ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Laquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.
- C. ASTM D4263 - Standard Test Method for indicating moisture in concrete by the plastic sheet method.

1.4 DEFINITIONS

- A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.5 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with three years experience.
- B. Applicator: Company specializing in commercial painting and finishing approved by product manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

1.7 SUBMITTALS

- A. Submit product data under provisions of Section 013300.
- B. Provide product data on all finishing products.
- C. Submit samples and color charts under provisions of Section 013300.
- D. Submit manufacturer's application instructions under provisions of Section 013300.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 016000.
- B. Store and protect products under provisions of Section 016000.
- C. Deliver products to site in sealed and labelled containers; inspect to verify acceptance.
- D. Container labelling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 72 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

1.10 EXTRA STOCK

- A. Provide a one gallon container of each color and type to Owner. Quart containers will be acceptable for touchup paint and for small items.

2. PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PAINT, PRIMERS, BLOCK FILLER, AND FIELD CATALYZED COATINGS

- A. Coronado Paint Company
- B. Glidden Division I.C.I.
- C. Sherwin Williams.
- D. Substitutions: Under provisions of Section 016000.

2.2 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.3 FINISHES

- A. Refer to schedule at end of Section for surface finish and color schedule.

3. PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Located Wood: 15 percent, measured in accordance with ASTM D2016.
 - 4. Exterior Located Wood: 15 percent, measured in accordance with ASTM D2016.
 - 5. Concrete Floors: 14 percent, measured in accordance with ASTM D4263.

- D. Beginning of installation means acceptance of existing surfaces.

3.2 PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect work of this Section.
- C. Seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
- G. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved by using a pH pencil or pH range paper, pH should be 11 or less prior to application of coatings.
- H. Copper Surfaces Scheduled for a Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- I. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
- J. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- K. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- L. Exterior Face Brick: Verify that brick installed as part of the work has been cleaned according to Section 4500. Power wash existing face brick scheduled to receive coatings with masonry detergent.
- M. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- N. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution,

ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

- O. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- P. Interior Wood Items Scheduled to Receive Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- Q. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.
- R. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.4 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Sand lightly between coats to achieve required finish.
- E. Allow applied coat to dry before next coat is applied.
- F. Prime back surfaces of interior and exterior woodwork with primer paint.

3.5 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.6 GENERAL FINISH SPECIFICATIONS

- A. Masonry (M.)
 - 1. M-1. Interior

Surface:

Preparation: Thoroughly wash and rinse surfaces, removing dirt, dust, grease and oil. Use appropriate detergent cleanser. Remove loose or flaking paint and feather sand edges for a smooth uniform surface. Dull glossy surfaces.

Primer: Apply a smooth textured modified epoxy block filler which has a solids by volume value of 50%, and a spreading rate of 80 to 100 square feet per gallon on dense masonry.

Finish Coats: Apply two coats of a two component, high build poly-amide cured, epoxy, which has a solids value of 56% at a minimum dry film thickness of 5.0 mils per coat and a coverage of 180 square feet per gallon.

- B. Ferrous Metals (F.M.)
 - 1. F.M.-1. Exterior/Interior - severe exposure.

Surface

Preparation: SSPC SP6 Commercial Blast Cleaning.

Shop or

Field Coat: Apply one coat of 54% volume solids, two component poly-amide cured high build epoxy primer. At a dry film thickness of 3.0 mils and a coverage of 289 square feet per gallon.

First Coat: Apply one coat of a 56% volume solids, two component poly-amide cured high-build epoxy. At a minimum dry film thickness of 3.0 mils and a coverage of 300 square feet per gallon.

Second Coat: Apply one coat of a 54% volume solids aliphatic polyester polyurethane enamel. At a minimum dry film thickness of 1.5 mils and a coverage of 577 square feet per gallon.

- C. Concrete (C.)
 - 1. C-1. Concrete Floors

Surface:

Preparation: Thoroughly wash and rinse surfaces, removing dirt, dust, grease and oil. Use appropriate detergent cleanser.

Remove loose or flaking paint and feather sand edges for a smooth uniform surface. Dull glossy surfaces.

Primer: Apply one coat of epoxy modified acrylic floor finish, thinned 15%, to exposed bare areas, with a coverage of 350 square feet per gallon.

Finish Coat: Apply two coats of epoxy modified acrylic floor finish with a coverage of 350 square feet per gallon.

D. Wood (W.)

1. W-1. Exterior and Interior

Surface

Preparation: Surface must be dry, clean, and free of contaminants. Sand rough areas.

Primer: Apply a 53% volume solids alkyd wood primer at a dry film thickness of 2.0 mils and a coverage of 425 square feet per gallon.

Finish Coats: Apply two coats of a 54% volume solids alkyd enamel, at a dry film thickness of 2.0 mils per coat and a coverage of 400 square feet per gallon.

E. Drywall (D.)

1. D-1. Drywall (Gypsum Board)

Surface

Preparation: Surface must be dry, clean and free of contaminants. Sand joint compound smooth and feather edges.

Finish Coats: Apply two coats of a 43% volume solids acrylic latex at a dry film thickness of 2 mils per coat and a coverage of 345 square feet per gallon.

F. Galvanized Metals (G.)

1. G-1. Interior

Surface

Preparation: SSPC-SP1 Solvent Cleaning.

Primer: Apply one coat of Epoxy Zinc Chromate primer poly-amide with 52% solids at a coverage of 375 square feet per gallon.

Finish Coats: Apply two coats of a 56% volume solids, poly-amide cured high-build epoxy at a dry film thickness of 3.0 mils per coat and a coverage of 300 square feet per gallon.

2. G-2. Exterior

Surface Preparation:	SSPC-SP1 Solvent Cleaning.
Primer:	Apply one coat of Epoxy Zinc Chromate primer poly-amide with 52% solids at a coverage of 375 square feet per gallon.
First Coat:	Apply one coat of a 56% volume solids, poly-amide cure high-build epoxy at a dry film thickness of 3.0 mils and a coverage of 300 square feet per gallon.
Finish Coat:	Apply one coat of a 54% volume solids, aliphatic polyester polyurethane enamel at a minimum dry film thickness of 1.5 mils and at a coverage of 577 square feet per gallon.

3.8 PAINTS AND COATINGS SCHEDULE

- A. Application: Materials shall be applied to the following surfaces and areas in accordance with the guidelines developed within the "General Finish Specifications".
- B. Finish M-1: Interior exposed concrete block.
- C. Finish FM-1: Ferrous materials including, but not limited to, structural steel, miscellaneous metals, doors and frames, non-insulated piping, and equipment not included under Finish FM-2 disturbed or installed as part of the work as indicated in the schedule. Stainless steel, aluminum and plastic components specified with the above items shall be painted only as directed by the Architect.
- D. Finish G-1: Interior galvanized items, i.e. structural members, frames, exposed ductwork, conduit, etc. disturbed or installed as part of the work and as indicated in the schedule.
- E. Finish G-2: Exterior galvanized items, i.e. structural members, frames, etc. disturbed or installed as part of the work and as indicated in the schedule.
- F. Finish C-1: Interior concrete floors and as indicated in the schedule.
- G. Finish W-1: Exposed wood disturbed or installed as part of the work.
- H. Finish D-1: Exposed drywall (gypsum board) disturbed or installed as part of the work and as indicated in the schedule.

END OF SECTION

SECTION 10 42 60

SIGNAGE & GRAPHICS

1 PART 1 GENERAL

1.1 SECTION INCLUDES

- A. ADA Restroom Signs.

1.2 RELATED SECTIONS

- A. Section 013300 – Submittal Procedures.

2 PART 2 PRODUCTS

2.1 MATERIALS

- A. Restroom ADA Sign - 6"x9", exterior grade, plastic ADA, Braille/Tactile sign. Mechanically fasten to masonry block walls adjacent to restroom doors or where shown on drawings.
 - 1. (1) Men's and (1) Women's sign.
 - 2. (2) Family Restroom signs.
 - 3. (2) Nursing Room signs.
 - 4. See "Reference-T2.0" drawing for additional information.
- B. Tornado Shelter Sign – As shown on drawings.

3 PART 3 EXECUTION

3.1 PREPARATION

- A. Review all manufacturer installation guidelines and recommendations.

3.2 STORAGE

- A. All equipment shall be stored in original manufacturer containers and protected from construction conditions, weather, theft, and vandalism until time of installation.

3.3 INSTALLATION

- A. Assemble equipment components according to manufacturer instructions, installation guidelines and recommendations.
- B. Replace all damaged components prior to final inspection.
- C. Finish according to specific use requirements.

END OF SECTION

SECTION 10 80 00

TOILET AND BATH ACCESSORIES

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Toilet accessories.
- B. Grab Bars.
- C. Toilet Partitions.
- D. Attachment hardware.
- E. Hand Dryers.

1.2 REFERENCES

- A. ANSI/ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.
- B. ANSI/ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
- C. ANSI/ASTM A386 - Zinc Coating (Hot-Dip) on Assembled Steel Products.
- D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- E. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

1.3 SUBMITTALS

- A. Submit product data, samples and manufacture installation instructions under provisions of Section 01 33 00.
- B. Provide product data on accessories describing size, finish, details of function, attachment methods.
- C. Submit two samples of each component illustrating color and finish.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable code for installing work.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate the work of this Section with the placement of internal wall reinforcement to receive anchor attachments.

2. PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ASI, American Dryer, Bobrick, Mills Bradley, Franklin Brass or approved equals.

2.2 MATERIALS

- A. Sheet Steel: ANSI/ASTM A366.
- B. Stainless Steel Sheet: ASTM A167, Type 304.
- C. Tubing: ASTM A269, stainless steel.
- D. Adhesive: Two component epoxy type, waterproof.
- E. Fasteners, Screws, and Bolts: Hot dip galvanized.
- F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FABRICATION

- A. Weld and grind smooth joints of fabricated components.
- B. Form exposed surfaces from single sheet of stock, free of joints.
- C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- D. Back paint components where contact is made with building finishes to prevent electrolysis.
- E. Shop assemble components and package complete with anchors and fittings.
- F. Provide steel anchor plates, adapters, and anchor components for installation.
- G. Hot dip galvanized exposed and painted ferrous metal and fastening devices.

2.4 FACTORY FINISHING

- A. Galvanizing: ANSI/ASTM A123 to 1.25 oz/sq yd.
- B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- C. Enamel: Pretreat to clean condition, apply one coat primer and minimum two

coats epoxy baked enamel.

- D. Chrome/Nickel Plating: ANSI/ASTM B456, Type SC 2 polished finish.
- E. Stainless Steel: No. 4 satin luster finish.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings.
- B. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site at appropriate time for building-in.
- B. Provide templates and rough-in measurements as required.
- C. Verify exact location of accessories for installation.

3.3 INSTALLATION

- A. Install fixtures, accessories and items in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.

3.4 SCHEDULE

- A. Rest Rooms/ Nursing Rooms:
 - 1. Toilet Partitions: as indicated on drawings, Mills Bradley Series 400 mounted overhead-braced solid phenolic restroom partitions or approved equal. Color by Owner.
 - 2. Hand Dryer: (see dwgs. for qty.) - surface mounted, automatic sensor, and vandal resistant. Use Xlerator model XL-SB or approved equal.
 - 3. Stainless Steel Grab Bars: as indicated on drawings or required by codes. Grab bars shall be 1 1/2" O.D. with concealed mounting - ASI 18 gage stainless steel or approved equal.
 - 4. Dual Roll Toilet Paper Dispenser: (1) per water closet, Bobrick B-2740 with theft-resistant spindle key or approved equal.
 - 5. Deck-Mounted Soap Dispenser: (1) per lavatory, Bradley model 6-3500 Linea Series. Infrared sensor operation, liquid soap type, top fill, battery pack option. Finish type by Owner.
 - 6. Drain & Piping Covers: (1) per lavatory, Truebro Lav Shield (White), or approved equal.
 - 7. Mirror: (see dwgs. for sizes and qty.) all heights ar 2'-8", 304 stainless steel sheet #8 mirror, or approved equal. Mechanically fasten to masonry wall.

8. Sanitary Napkin Disposal: (see dwgs. for qty.) – surface mounted, Bobrick B-270, stainless steel, or approved equal.

END OF SECTION

SECTION 22 05 00
PLUMBING SCOPE OF WORK

1 GENERAL

1.1 SCOPE OF WORK

- A. Contractor shall provide all labor, materials, equipment, permits, inspection fees, utility company charges, supervision and other items noted in contract General Conditions necessary to yield completely operable and tested systems as shown on the Plans and specified herein. As shown and noted on plans, details, and specifications the plumbing work includes, but is not limited to, the following:
1. Domestic hot and cold water systems from source to all points of use, including water heaters, circulating pumps (if applicable) on hot water return system, backflow preventers at locations requiring their use, and chlorination of systems prior to occupancy.
 2. Purchase and installation of potable water meter including shutoff and bypass as required by the local municipality.
 3. New plumbing fixtures and trim, wall hydrants or hose bibbs, floor drains, trench drains, roof drains, cleanouts and related items.
 4. Natural gas piping to all points of use, and all necessary costs associated with the gas utility company, including all valves, pressure regulators, and other required system equipment.
 5. Condensate drainage system from air handling units, terminal units, cooling coils, intake plenums, etc.
 6. Insulation for piping systems and equipment as specified. Reference 23 07 00 HVAC Insulation for all thermal insulation requirements for plumbing equipment.
- B. Exterior aboveground piping which is not insulated or otherwise covered shall be primed/painted. See Plumbing Plans for special gas painting notes.
- C. Touch-up painting of damaged materials furnished by this contractor and damaged by this contractor. Each mechanical contractor shall be responsible for replacement/patching of all finish materials which have been disrupted and/or damaged as a result of their construction procedures. All materials shall match original and all work shall be done by experienced field tradesmen.
- D. Flushing, cleaning, and pressure testing of installed systems. Complete pressure test form.
- E. Cleanup associated with work of respective trades.
- F. Maintain records of changes to the drawings as they occur in the field and submit same to the Owner and/or Architect/Engineer as requested within 90 days after the date of system acceptance. See the General Conditions of this specification for additional information.
- G. Balancing of hot water recirculation pump (if required) shall be included by the Test and Balance Contractor as specified in Section 23 05 93.
- H. Operation and Maintenance Manuals for all equipment provided, to be submitted prior to project close-out and final payment. Include at a minimum all information required by the Michigan Energy Code.
- I. All equipment furnished and installed shall comply with the relevant agency listing, testing, and labeling requirements of the 2018 Michigan Plumbing Code.

- J. No asbestos or mercury containing materials, materials capable of discharging lead into potable water or air systems, or materials capable of releasing other hazardous substances to the facility air environment, drainage systems, or water systems shall be used.
- K. Coordination with other trades. Contractor shall assist in the field layout and coordination of equipment, ductwork, and piping installation and their relation with other trades at no additional cost to the owner.
- L. Provide minimum one (1) year warranty against defects for materials and installation, unless otherwise indicated.
- M. Cost of State of Michigan Plumbing and Mechanical Permits.
- N. Job Site safety is the responsibility of the contractor. The architect/engineer bears no responsibility for job-site safety.
- O. Owner training in operation and maintenance of installed equipment and systems. Using the Operating and Maintenance manuals, balancing report data, and construction plans and specifications, contractor shall instruct owner's representatives in the proper operation of the equipment and systems installed to their mutual satisfaction. This activity shall take place near the point of substantial completion and will be considered one of the final punch list issues. Training shall consist of a period of "classroom" instruction providing a general overview of the facility equipment and systems plus a tour of the facility and its equipment pointing out specific maintenance issues for each area and item of equipment. When the training is complete owner shall be provided with a training certificate by the contractor by which the owner will acknowledge that such training has taken place.
- P. Nomenclature and Abbreviations:
 - 1. Spicer Group herein shall be referred to as the Engineer.
 - 2. The Mechanical Contractor herein may be referred to as the MC (and shall procure and install all plumbing systems and piping.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.

1.2 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Identification painting.

1.3 REFERENCE STANDARDS

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.
- B. ASTM D 709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Control Panels: Nameplates.
- B. Instrumentation: Tags.
- C. Major Control Components: Nameplates.
- D. Piping: Pipe markers.
- E. Pumps: Nameplates.
- F. Small-sized Equipment: Tags.
- G. Tanks: Nameplates.
- H. Valves: Tags.

2.2 MANUFACTURERS

- A. Brady Corporation.

- B. Champion America, Inc..
- C. Seton Identification Products.

2.3 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Black.
 - 4. Plastic: Conform to ASTM D 709.

2.4 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.5 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation.
 - 2. Kolbi Pipe Marker Co..
 - 3. Seton Identification Products.
- B. Comply with ASME A13.1.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.6 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. Plumbing Valves: Green.

3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.

- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Identify pumps, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Locate ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

A. Pipe Label Schedule

	<u>System</u>	<u>Wording</u>	<u>Background Color</u>
1.	Condensate	CONDENSATE	Green
2.	Domestic Cold Water	DOMESTIC COLD WATER	Green
3.	Domestic Hot Water	DOMESTIC HOT WATER	Green
4.	Domestic Hot Water Return	DOMESTIC HOT WATER RETURN	Green
5.	Fire Protection	FIRE PROTECTION WATER	Red
6.	Natural Gas	NATURAL GAS	Yellow
7.	Sanitary Vent	SANITARY VENT	Green
8.	Sanitary Drain	SANITARY DRAIN	Green
9.	Storm Drain (Primary)	STORM DRAIN (PRIMARY)	Green
10.	Storm Drain (Overflow/Emergency)	STORM DRAIN (OVERFLOW/EMERGENCY)	Green

END OF SECTION

SECTION 22 10 05

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for piping systems.
 - 1. Sanitary drain and vent.
 - 2. Domestic water.
 - 3. Natural Gas.
- B. Pipe Cleaning, Pipe Testing, and Disinfection of domestic water systems.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 – Firestopping.
- B. Section 23 07 00 – HVAC Insulation (Plumbing Piping must be insulated per Section 23 07 00).
- C. Section 31 20 00 – Grading, Excavation and Fill.

1.3 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005) (ANSI B16.18).
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).
- D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers; 2006.
- E. ASME B31.1 - Power Piping; The American Society of Mechanical Engineers; 2007 (ANSI/ASME B31.1).
- F. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).
- G. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- H. ASTM A 74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2009.
- I. ASTM A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel

and Alloy Steel for Moderate and High Temperature Service; 2007.

- J. ASTM A 888 – Standard Specification for Hubless Cast Iron Soil Pipe and fittings for Sanitary and Storm Drain, Waste, and Vent Piping Application (2013).
- K. ASTM B 32 - Standard Specification for Solder Metal; 2008.
- L. ASTM B 42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2002.
- M. ASTM B 88 - Standard Specification for Seamless Copper Water Tube; 2009.
- N. ASTM B 88M - Standard Specification for Seamless Copper Water Tube (Metric); 2005.
- O. ASTM C 564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2009a.
- P. ASTM C 1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications; 2000 (Reapproved 2005).
- Q. ASTM C 1277- Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- R. ASTM C 1540 – Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- S. ASTM D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2004 (Reapproved 2009).
- T. ASTM D 2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2009.
- U. ASTM D 2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2002).
- V. ASTM D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2008.
- W. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; 2005 (ANSI/AWWA C105/A21.5).
- X. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2007 (ANSI/AWWA C111/A21.11).
- Y. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2009 (ANSI/AWWA C151/A21.51).
- Z. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).
- AA. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2005.

BB. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2004

CC. MSS SP-67 - Butterfly Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2002a.

DD. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2006.

EE. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2005.

FF. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2008.

GG. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2002.

HH. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1996.

II. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2009.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Part 2 articles that list manufacturers: Provide products by one of the named manufacturers, subject to compliance with requirements.

2.2 SANITARY DRAIN AND VENT PIPING, BELOW GRADE

- A. PVC Pipe: ASTM D2729.
1. Fittings: PVC.
 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.3 SANITARY DRAIN AND VENT PIPING, ABOVE GRADE

- A. PVC Pipe (Exposed in mechanical chases behind cells and vent piping that is not located in return air plenums only): Solid wall, schedule 40; ASTM D 2665.
1. Fittings: PVC ASTM D 2665 socket fittings, made to ASTM D 3311, drain, waste, and

- vent patterns.
 - 2. Joints: Solvent welded, with ASTM D 2564 solvent cement.
 - 3. At no time will "Foam Core" type PVC piping be allowed.
- B. Condensate drainage piping shall be solid wall schedule 40 PVC.
- 1. Where exposed piping must be insulated and wrapped in white PVC jacket.
 - 2. In return air plenums condensate drain piping: CPVC Pipe, ASTM F 441/F441M, schedule 40 with ASTM F 438 CPVC socket fittings and CPVC solvent cement with a VOC content of 490 g/L or less when calculated by EPA method 24.

2.4 SANITARY DRAIN FORCE MAIN PIPING

- A. PVC sanitary sewer force main pipe shall be green in color. Provide approved PVC pressure pipe. ASTM D1784.
- 1. The joints for pipe 1-1/2 inch in diameter and larger shall be push-on (bell and spigot) joints designed so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment. The joints shall be designed for thermal expansion or contraction experienced with the total temperature change of at least 75° F in each joint per length of pipe. Joints shall comply with ASTM-D3139.
- B. Galvanized steel Pipe: ASTM A 53/A 53 M, Type E, Standard Weight class. Include square cut grooved or threaded ends o match joining method.
- 1. Fittings: Galvanized Gray Iron threaded pressure fittings, ASME B16.4, Class 125, standard pattern.
 - 2. Grooved mechanical couplings for galvanized steel piping, ASTM F 1476, Type I, include ferrous housing sections with continuous curved keys, EPDM rubber gasket suitable for hot or cold water, bolts and nuts.
 - a. Approved manufacturers:
 - (1) Anvil International.
 - (2) Grinnell.
 - (3) Shurjoint Piping Products.
 - (4) Victaulic Co.
- C. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
- 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B 32, alloy Sn95 solder for piping through 3”.
 - 3. Alternate fittings and joints for piping 2” and larger: Roll grooved Victaulic Style 607 rigid coupling and Style 641 flange adapters with Grade EHP EPDM gaskets, NSF 61 rated for hot water to 250°F; or equivalent by Grinnel, Gruvlok, or Shurjoint. If grooved pipe is used, only one manufacturer shall be used per Bid Division and the manufacturer’s representative shall conduct on-site training of field personnel and visit the project during construction and review for proper installation of their product. Grooving tools shall be of the same manufacturer as the grooved components.

2.5 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B 42, annealed.
- 1. Fittings: ASME B16.26, cast bronze.
 - 2. Joints: Flared.
 - 3. Size: For piping through 2”.

- B. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch diameter rods.
 - 3. Size: For piping 3" and larger.

2.6 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B 32, alloy Sn95 solder for piping through 3".
 - 3. Alternate fittings and joints for piping 2" and larger: Roll grooved Victaulic Style 607 rigid coupling and Style 641 flange adapters with Grade EHP EPDM gaskets, NSF 61 rated for hot water to 250°F; or equivalent by Grinnel, Gruvlok, or Shurjoint.
 - 4. Exposed hot, cold, and drain water piping in kitchens shall be chrome "plated" copper, un-insulated, meeting local health department requirements. This may be achieved by use of Chrome Plate Chrome Finish enamel by DAP #193 applied using manufacturer's recommendations. Where piping is cold enough to sweat, it shall be insulated and covered with 0.020 Celco PVC jacket, sealed wash down tight. Refer to specification section 220719 for more information.
 - 5. In lieu of all soldered copper system, Contractor may use the following: Potable water piping (Type L ASTM B-88 hard drawn copper) sizes 1/2" through 4" shall be assembled using the Pro-Press system by VIEGA/RIDGID or NIBCO Press System using copper press fittings and EPDM gaskets ANSI/NSF-61 approved for potable water service. Install per manufacturer's written installation instructions.

2.7 STORM DRAIN PIPING, BELOW GRADE

- A. PVC Pipe (Exposed in mechanical chases behind cells and vent piping that is not located in return air plenums only): Solid wall, schedule 40; ASTM D 2665.
 - 1. Fittings: PVC ASTM D 2665 socket fittings, made to ASTM D 3311, drain, waste, and vent patterns.
 - 2. Joints: Solvent welded, with ASTM D 2564 solvent cement.
 - 3. At no time will "Foam Core" type PVC piping be allowed.
- B. Condensate drainage piping shall be solid wall schedule 40 PVC.
 - 1. In return air plenums condensate drain piping: CPVC Pipe, ASTM F 441/F441M, schedule 40 with ASTM F 438 CPVC socket fittings and CPVC solvent cement with a VOC content of 490 g/L or less when calculated by EPA method 24.

2.8 STORM DRAIN PIPING, ABOVE GRADE

- A. PVC Pipe (Exposed in mechanical chases behind cells and vent piping that is not located in return air plenums only): Solid wall, schedule 40; ASTM D 2665.
 - 1. Fittings: PVC ASTM D 2665 socket fittings, made to ASTM D 3311, drain, waste, and vent patterns.
 - 2. Joints: Solvent welded, with ASTM D 2564 solvent cement.
 - 3. At no time will "Foam Core" type PVC piping be allowed.
- A. Cast Iron Pipe: ASTM A 888, CISPI 301, NSF International, hub-less cast iron soil pipe.
 - 1. Fittings: ASTM A 888, CISPI 301, NSF International, hub-less cast iron soil pipe fittings.

2. Couplings: ASTM C 1540, CISPI 310, Heavy duty, complete assembly of ASTM C 564 rubber sleeve with center pipe stop, corrugated metal shield, and stainless steel clamp with corrosion resistant fasteners.
 - a. Manufacturers:
 - (1) Anaco-Husky
 - (2) Charlotte Pipe and Foundry Company.
 - (3) Fernco, Inc..
 - (4) Mission Rubber Company.
 - (5) Tyler Pipe, Soil Division.

2.9 NATURAL GAS PIPING, BELOW GRADE

- A. Steel Pipe: ASTM A 53/A 53M Schedule 40 black.
 1. Fittings: ASTM A 234/A 234M, wrought steel welding type.
 2. Joints: ASME B31.1, welded.
 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
- B. Vented Sleeves for underground gas piping inside buildings shall utilize flame retardant polypropylene equal to Spears CPVC piping meeting ASTM E-84 and 25/50 flame spread/smoke ratings and joined together using Spears LW-5 one step solvent cement welding process or approved equal. Piping inside sleeves may be either as specified above or ASTM Type K annealed seamless copper tubing or ASTM B210 or B 241 aluminum tubing meeting local codes.

2.10 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A 53/A 53M Schedule 40 black.
 1. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A 234M, wrought steel welding type.
 2. Joints: NFPA 54, threaded or welded to ASME B31.1.
- B. Fire Marshal approved IAS (formally AGA) rated corrugated flexible stainless steel tubing and fittings may be used for final laboratory or appliance connections after the shutoff valve, and may in no case be used underground. This type of piping may be utilized where individual, dedicated branches from a gas pipe header located above the ceiling, are routed in a vented sleeve, directly to the island fixture. No joints allowed below grade. Prior approval from Engineer is required before installation of this piping system. Verify with engineer for applications not listed above.
- C. Where gas piping to rooftop equipment is supplied from below, it shall penetrate the roof outside the rooftop equipment roof curbs in such a manner that the penetration can be properly sealed to the roof. Where applicable use "Pate" pipe curb and coordinate with the roofing contractor. When gas piping passes through a ceiling to feed equipment on the roof above, all shutoff and/or isolation valves, regulators, and/or relief valves shall be located after the roof penetration and not within the ceiling space.

2.11 FLANGES, UNIONS, COUPLINGS AND DIELECTRIC ISOLATORS

- A. Unions for Pipe Sizes 3 Inches and Under:
 1. Ferrous pipe: Class 150 malleable iron threaded unions.

2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Size Over 1 Inch:
1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Grooved and Shouldered Pipe End Couplings:
1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
 2. Sealing gasket: "C" shape composition sealing gasket.
- D. Dielectric Connections: Isolate all dissimilar piping materials with insulating couplings equal to V-Line, Walter Valet, Stockham, or Viking. ClearFlow nipples made by Precision Plumbing Products of appropriate rating may also be used.

2.12 PIPE HANGERS AND SUPPORTS

- A. Plumbing Piping - Drain, Waste, and Vent:
1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- B. Plumbing Piping – Water and Gas:
1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 10. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
 11. Vertical Support: Steel riser clamp.

12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
 14. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
 15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Exterior pipe hangers shall be galvanized.
- D. Piping routed over roofs shall be supported as shown on the plans or if not shown, supported in a manner that protects the roofing system, using prefab roller or strut pipe supports equal to Erico Pipe Pier or similar by Miro Industries.

2.13 GATE VALVES

- A. Manufacturers:
1. Nibco, Inc; Model T134 screwed, S134 sweat, F617-O flanged.
 2. Milwaukee Valve Company; Model 1151 screwed, 1169 sweat, F-2885A flanged.
 3. Stockham B120 screwed, B124 sweat, G623 flanged.
 4. Hammond IB629 screwed, IB648 sweat, IR1140 flanged.
 5. Watts B3100 screwed, B3111 sweat, F503 flanged.
- B. Up To and Including 2.1/2 Inches: MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder or threaded ends.
- C. 3 Inches and Larger: MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.14 GLOBE VALVES

- A. Manufacturers:
1. Nibco, Inc; Model T234-Y screwed, S235-Y sweat.
 2. Milwaukee Valve Company; Model 590T screwed, 1590T sweat.
 3. Stockham B-22T screwed, B-24T sweat.
 4. Hammond IB413T screwed, IB 423 sweat.
 5. Watts B4010-T screwed, B4011-T sweat.
- B. Up To and Including 2.1/2" Inches: MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder or threaded ends.
- C. 3 Inches and Larger: MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.15 BALL VALVES

- A. Manufacturers:
1. Conbraco Industries; Model 70LF-100 screwed, 70LF-200 sweat.
 2. Nibco, Inc; Model T-580-70 screwed, S-580-70 sweat.

3. Milwaukee Valve Company; Model BA-100 screwed, BA-150 sweat.
 4. Hammond 8501 screwed, 8511 sweat.
 5. Watts B6000 screwed, B6001 sweat.
- B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder or threaded ends.
- C. For natural gas service use a two piece, full port bronze ball valve marked WOG permanently on the body, 600 psig CWP, that meets the standards in Table 409.1.1 the of the International Fuel Gas Code such as the Legend Model T-1001 (or equivalent). Other acceptable manufacturers are Apollo (Conbraco), Watts, and Hammond.

2.16 PLUG VALVES

- A. Manufacturers:
1. Lee Brass Company.
 2. McDonald, A. Y. Manufacturing Company.
 3. Mueller Company; Gas Products Division.
- B. Construction:
1. Bronze Plug Valves: Bronze complying with ASTM B 584, bronze plug, threaded, socket, or flanged ends, square head or lug type operator, 125 psig, and marked WOG permanently on the body.
 2. Cast Iron Plug Valves: Cast iron complying with ASTM A 126, Class B, bronze or nickel plated cast iron plug, thermoplastic coated seat, natural gas compatible stem seal, threaded or flanged ends, square head or lug type operator, 125 psig, and marked WOG permanently on the body.

2.17 BUTTERFLY VALVES

- A. Manufacturers:
1. Keystone Model 222-784.
 2. Apollo Model 143.
 3. Milwaukee Valve Company; Model HL Series.
 4. Nibco LD3010.
 5. Victaulic Series 608 or Anvil Gruvlok 7700 for grooved butterfly valve.
- B. Construction 2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, aluminum bronze disc, resilient replaceable EPDM seat, lug ends, extended neck, 10 position lever handle.
- C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 10 feet above floor in mechanical rooms.
- D. Grooved Valve Construction 2 Inches and Larger: 300 psi CWP, cast iron body, EPDM encapsulated disc, grooved ends, 10 position lever handle. Gear operator for 8" and larger. Materials shall conform to ANSI/NSF 61 for potable water service.

2.18 BALANCING VALVES

- A. Manufacturers:
 1. ITT Bell & Gossett.
 2. Nibco, Inc.
 3. Taco, Inc;
 4. Watts Industries, Inc.; Water Products Div.

- B. Construction: Class 125, Brass or bronze body ball or y-pattern globe valve with two read out ports and memory setting indicator with memory stop and calibrated nameplate with valve settings, designed for positive shut off.

- C. Size: Same as connected piping or smaller as required to achieve flow indicated on drawings. Refer to plumbing plans.

2.19 SWING CHECK VALVES

- A. Manufacturers:
 1. Hammond Valve; Model IB 946 screwed, IR1124 flanged.
 2. Nibco, Inc; Model T433 screwed, F918-B flanged.
 3. Milwaukee Valve Company; Model 510T screwed, F-2974 flanged.
 4. Stockham Model B-322T screwed, G-931 flanged.

- B. Up to 2.1/2 Inches: MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded ends.

- C. Over 2.1/2 Inches: MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.20 AIR ADMITTANCE VALVES

- A. Individual air admittance valves shall conform to ASSE 1051 and shall be equal to Oatey "Sure-Vent" or Studor "Maxi-Vent" or "Redi-Vent".

- B. Air admittance valves shall be used where indicated on the plans and shall not be substituted where vent piping routed to the outdoors is shown. Contractor shall confirm the proper application and air admittance valve size prior to installation and at all locations where the AAV is installed in walls, bulkheads, etc..., access doors shall be installed for servicing purposes. At locations where installed above removable ceilings, provide labels on ceiling grid for location purposes.

2.21 STRAINERS

- A. Manufacturers: Armstrong International, Inc..

- B. Size 2 inch and Under:
 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

- C. Size 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

- D. Size 6 inch and Larger: 1Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.22 DRAINS

A. Manufacturers:

1. Josam Company: www.josam.com.
2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
3. Zurn Industries, Inc: www.zurn.com.
4. MIFAB Inc.
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.23 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Josam Company: www.josam.com.
3. Zurn Industries, Inc: www.zurn.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.24 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Watts Regulator Company: www.wattsregulator.com.
3. Zurn Industries, Inc: www.zurn.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F (-73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.
- G. Install pipe hangers on rod with double nuts to prevent movement from vibration. After the final pipe elevations at set with the insulation inserts installed (if any), secure the hanger with the double nuts.
- H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.
- I. Cushion all traps and bearings to minimize transfer of sound; firmly anchor all pipes in position; provide complete isolation of dissimilar metals; provide air chambers at all fixtures.
- J. Inspect each piece of pipe, tubing, fittings, and equipment for defects and obstructions; promptly remove all defective material from the job site.
- K. Install pipes to clear all beams and obstructions; do not cut into or reduce the size of load carrying members without the approval of the Architect/Engineer.
- L. Locate all vent pipe discharges in accordance with plumbing and mechanical codes having jurisdiction relative to distances from air intakes, windows, and other situations where their presence constitutes a hazard (generally at least ten (10) feet horizontal distance from or three (3) feet vertical distance above air intakes).
- M. Flash all vent stacks at the roof. Vent stack installation shall be coordinated with roofing material on project. Flashing shall extend up and be turned over the top of the vent pipe at least one inch (1") to fit tightly against the side of the vent pipe. Flashing shall extend eight inches (8") or more on the roof surface, overlapped by and cemented to the roofing. Each vent stack shall be increased to a minimum size of three inches (3") through roof and shall extend above the roof a minimum of twelve inches (12"). Grade horizontal vent lines 1/8" per foot, minimum.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- O. Prepare steel, cast iron, and galvanized unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00. Do not paint copper, stainless steel, or nonmetallic pipe; or insulated pipe with PVC, vinyl, or aluminum jacket.
- P. Excavate in accordance with Section 31 23 16.
- Q. Backfill in accordance with Section 31 23 23.
- R. Install bell and spigot pipe with bell end upstream.
- S. Install valves with stems upright or horizontal, not inverted.

- T. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- U. Install water piping to ASME B31.9.
- V. PVC Pipe: Make solvent-welded joints in accordance with ASTM D 2855.
- W. Install air admittance valves in an accessible location. If the valves are located in an inaccessible location, such as behind walls, provide and install an access door.
- X. Pipe Penetrations passing through walls, floors, partitions, ceilings, and foundations
 - 1. Pipe penetrations shall be neatly cut or cored allowing adequate space around the pipe, including insulation and jacketing as necessary.
 - 2. Pipe insulation and jacketing shall pass through non-rated penetrations. Maintain vapor barrier for cold services.
 - 3. At pipe penetrations through fire-rated walls, floors, ceiling, partitions, and foundations, the cavity between pipes and sleeves shall be filled with mineral wool (refer to Sections 22 07 19 and 23 07 19), and each end sealed with intumescent material. Refer to Section 07 81 23.
 - 4. Except where indicated otherwise, sleeves are required for all piping passing through concrete or block walls, floors, ceiling, partitions, and foundations.
 - a. Sleeves through non-rated wall, floor, ceiling, partition, and foundation penetrations shall be 18 gauge galvanized sheet metal unless otherwise specified. Seal around the outside of the sleeve with mortar compatible with the wall material.
 - b. Sleeves through fire-rated areas wall, floor, ceiling, partition, and foundation penetrations shall be standard weight steel pipe, cast iron pipe, or other material approved by the firestopping manufacturer. Seal around the outside of the sleeve with mortar compatible with the wall material and approved by the firestopping manufacturer. See Firestopping Section 07 84 00.
 - c. Pipes passing through walls or foundations below grade where fire rating is not required shall utilize cast-in-place mechanical joint wall sleeves. Link-Seal or equivalent bolted rubber seals may also be used.
 - 5. Penetrations through gypsum board, acoustical tile or similar “soft” materials shall be neatly cut allowing space around the pipe and insulation. Cover the penetration with chrome plated or painted escutcheons in finished areas.
 - 6. Penetrations through metal sandwich panel walls or ceilings shall be neatly cut and sealed or sleeved to protect the sandwich panel insulation.
 - 7. Seal around pipes through fire rated penetrations with fire stopping material. See Firestopping Section 07 84 00.
 - 8. Sleeves shall be flush with walls unless otherwise indicated. Cover the penetrations with chrome plated or painted escutcheons in finished areas.
- Y. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

- Z. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
 2. Support horizontal piping as scheduled.
 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 4. Place hangers within 12 inches of each horizontal elbow.
 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 8. Provide copper plated hangers and supports for copper piping.
 9. Oversized pipe hangers shall be installed for all pipes carrying fluids below ambient temperature ("cold pipes") to allow the insulation to pass through the hanger without cutting or piecing. Maintain a continuous vapor barrier. Install pipe shields indicated in Insulation Specification Section 22 07 19 to protect insulation and vapor barrier.
 10. No piping shall be hung from the piping of other trades or systems. Hangers shall be same material as the piping such that neither the hanger nor suspended piping is subject to electrolytic decay.
 11. Drainage piping support shall meet requirements of respective pipe manufacturer and local codes.
 12. Support nonmetallic pipe per the manufacturer's recommendations.
 13. Locate hanger supports and accessories to support pipe, lines, valves, joints, and additional concentrated loads. They shall not restrict free thermal expansion unless otherwise shown. Hangers shall not be hung from structural steel or intermediate members or cross bracing in a manner that may contribute to unnatural deflection and potential failure of the member, e.g. lateral load from cross brace in compression could yield to cross brace failure and risk of damage to main structure.
 14. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 CLEANING SANITARY DRAINS

- A. Prior to putting systems into use and before the sewer is tested thoroughly flush the sewers and verify that all new and existing sanitary drains are free of construction debris. If this simple flushing procedure does not readily verify the piping is intact and clean, the sewer shall be cleaned as follows:
- B. The Contractor shall furnish an inflatable rubber ball of a size that will inflate to fit snugly into the sewer to be tested. The ball shall be placed in the upstream manhole and water shall be introduced behind it. The ball shall pass through the pipe with only the force of the water propelling it. All debris flushed out ahead of the ball shall be removed at the first manhole where its presence is noted.
- C. In the event debris stops the ball, the Contractor shall remove the obstruction by further flushing or cleaning. In the event a damaged pipe stops the ball, the Contractor shall take the following action:
 1. New Piping: Repair the sewer as the case may be.
 2. Existing Piping: Report the damaged pipe to the Architect/Engineer for further direction.

D. Cleaning may also be accomplished by the use of a high-pressure water jet.

3.4 TESTING

A. General Procedures:

1. Furnish all required personnel and equipment and make all tests required to receive the approval of the Architect/ Engineer and all agencies having jurisdiction, particularly 2015 International Plumbing Code, 2015 Michigan Plumbing Code, or other applicable plumbing or local codes.
2. Piping shall be tested at a hydrostatic pressure to 50% over the system design pressure or at 125 psig, whichever is greater, except that plumbing fixtures and drainage piping shall be tested according to code requirements. Air Piping shall be drained and blown dry after completion of tests. Systems shall have no significant pressure loss for 24 hours. If defects are found, repeat tests after defects have been corrected.
3. Caulking of screwed joints or peening of welds shall not be permitted. In the event leakage occurs, pipe shall be dismantled, rethreaded or rewelded and new fittings shall be installed. Repeat tests after defects have been corrected.
4. Test laboratory gases piping at 125 psig with compressed air and leak detector solution including stem seal on valves. In addition, test hydrogen piping at 75 psig with hydrogen, and detector capable of hydrogen leak detection at joints and valves.
5. Concealed pipe shall be tested in sections, in such a manner which will not leave any pipe or joint untested.
6. Control devices, air vents and other parts not designated to stand pressures used in testing piping shall be removed or otherwise protected before testing the piping systems.
7. Use Piping Pressure Test Form from (attached) for record purposes where applicable.
8. Test storm and sanitary drainage piping in accordance with Michigan Construction Codes. See related test section for information.
9. Additional Testing Requirements:
 - a. All fabricated piping shall, as a minimum, meet the examination, inspection and testing requirements of ANSI B31.3.
 - b. Inspectors representing the Owner shall have access at all times while work on their contract is being performed to all sections of the worksite that concern the fabrication and erection of the piping on their contract. The inspectors shall be afforded all reasonable facilities to satisfy them that the work is being performed in accordance with the requirements of all applicable specifications and procedures.
 - c. All welding performed under this specification shall be subject to visual inspection. This visual inspection shall include an examination of joint details prior to welding, inspection for defects during welding and for defects, undercut, overlay and reinforcement dimensions after welding.
 - d. As far as is practicable, all pressure tests shall be complete system tests conducted in the presence of Architect/ Engineer representative. All pressure vessels; instruments and equipment connected to the piping shall be excluded from the tests.
 - e. Every precaution shall be taken during testing to insure the safety of the operator. Systems to be pressurized will be provided with appropriate gauges and pressure relieving devices.
 - f. All joints, including welds, are to be left un-insulated, unpainted, and exposed for examination during testing.
 - g. Equipment, which is not to be subjected to the pressure test, shall be either disconnected from the piping or isolated by blinds or other means during the test. Valves may be used provided that the valve is suitable for the proposed test pressure.
 - h. Expansion joints shall be provided with temporary restraint, if required, for the

- additional pressure load under test, or shall be isolated from the test.
- i. Pressure relief and thermal relief valves shall be excluded from these tests.
 - j. Before every test the piping systems shall be visually inspected to assure that there are not visual defects and that all connections are tight.
 - k. Control valves, unless being tested shall be set and maintained in the wide-open position.
 - l. Lines that are spring or counterweight supported and all vapor or gas lines shall be temporarily supported during test in order to support the test fluid load, if necessary.
 - m. Lines containing check valves shall have the pressure applied upstream of the check valve so that pressure is applied under the seat.
 - n. All in-line instruments, gauge glasses, flow meter pot, liquid level float gauges, and all other pressure parts of instruments shall be excluded from these tests.
 - o. Pneumatic testing of fiberglass reinforced plastic, glass, or plastic piping is not permitted.
 - p. Joints found to be defective shall be repaired and retested.
 - q. Retesting of lines after repairs shall be done at pressures originally specified for the test.
 - r. When pneumatic or hydrostatic tests are not appropriate, tests shall be as specified by the Architect/Engineer.
10. Test Reports:
- a. The Contractor shall make a record of the test applied to each piping system, which shall consist of the following data:
 - b. Line designation number.
 - c. Date of test.
 - d. Type of test, pressure applied, and length of time at test pressure.
 - e. Tested by:
 - f. Comments, if any:
 - g. Piping Pressure Test Report (attached) to be completed.
11. Hydrostatic Tests:
- a. The hydrostatic test pressure shall be calculated in accordance with applicable section of ANSI B31.3, but shall not exceed the maximum test pressure of any component included in the test.
 - b. Temperature and head adjustments shall be made in accordance with ANSI B31.3, Paragraphs 337.4.1 and 337.4.2.
 - c. Hydrostatic test pressures for fiberglass reinforced plastic, glass or plastic pipe, must not exceed manufacturer's recommended working pressure.
 - d. All hydrostatically tested systems shall be tested to one and one-half (1-1/2) times the design pressure or to a minimum pressure of fifty (50) psig, whichever is greater. All test pressures shall be maintained a minimum of ten minutes before visual examination of joints begins.
 - e. Hydrostatic test pressures shall not be applied until the piping system and the testing medium have reached thermal equilibrium.
 - f. During the tests, hydrostatic pressures shall be monitored and corrections shall be made to compensate for thermal expansion or contraction. By this procedure the test pressure shall be kept within five (5) psig or one percent, whichever is greater, of its intended value. All joints shall be visually examined for leakage during the test.
 - g. Tested systems shall be vented and drained immediately upon successful completion of the test. All process and solvent lines shall be dried by passing clean dry oil-free air through them until they are dried to the satisfaction of the Architect/Engineer or

- his representative.
 - h. No repair welding shall be done on any section of piping that contains water.
12. Pneumatic Tests:
- a. Air tests, when specified, shall be performed with clean, dry, oil-free air, or nitrogen, as required by process consideration. The source shall be equipped with appropriate pressure relief valves and gauges.
 - b. Air tests shall be performed at a test pressure in accordance with the applicable section of ANSI B31.3. The minimum test pressure shall be 50 psig.
 - c. Pneumatically tested systems shall include a preliminary check at not more than 50 psig. The system shall then be brought up to test pressure in 25 psig increments. Enough time shall be left between steps to allow the system to equalize strains, to inspect for leaks by soap and water method and to allow test media to reach thermal equilibrium. Flanges shall be taped.
 - d. During the test, pressures shall be monitored and corrections shall be made to compensate for thermal expansion or contraction. By this procedure, the test pressure shall be kept within five (5) psig of its intended value.
 - e. Tested systems shall be vented immediately upon successful completion of the test.
 - f. No repair welding shall be performed on a pressurized system.
 - g. Where both hydrostatic and pneumatic tests are run on a section of pipe, the hydrostatic test shall precede the pneumatic.
13. Vacuum Testing:
- a. The system shall receive a preliminary pneumatic pressure test at a minimum internal pressure of 15 psig in accordance with Section E of this specification.
 - b. The system shall be given an operational vacuum test using the operating vacuum pump or a special test pump. The system shall be considered acceptable if a design vacuum of 28" Hg is maintained for a period of one (1) hour and if the pressure does not rise more than 1 inch of Hg.
 - c. If Step 2 above is not successful, the system shall be retested per Step 1 above to locate the leak using soap and water, and then repaired and given another vacuum test.
14. Standing Water Test
- a. All portions of the system shall be filled with water.
 - b. Water shall stand for a period of not less than eight (8) hours.
 - c. The leak rate shall be as specified by "Sewer Design and Construction" - ACME M&R No. 37. Steel piping systems shall be leak tight.
 - d. If the system loses water faster than the rate specified, the leaking component shall be repaired and the system retested.

3.5 TESTING OF DRAINAGE AND VENT PIPING

- A. Drainage and vent piping shall be tested in accordance with the 2015 International Plumbing Code, Michigan Plumbing Code 2015, as applicable and as specified herein. The Contractor may test the piping with compressed air (pneumatic test) or with standing water, at his discretion.
- B. Pneumatic Tests:
 - 1. Air tests, when specified, shall be performed with clean, dry, oil-free air, or nitrogen, as required by process consideration. The source shall be equipped with appropriate

- pressure relief valves and gauges.
2. Air tests shall be conducted by forcing air into the system until there is a uniform gauge pressure of 5 psig, or sufficient to balance a 10 inch column of mercury. This pressure shall be held for a minimum test period of 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.
 3. Tested systems shall be vented immediately upon successful completion of the test.
 4. No repair welding shall be performed on a pressurized system.
 5. Where both hydrostatic and pneumatic tests are run on a section of pipe, the hydrostatic test shall precede the pneumatic.
 6. Standing Water Test: A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10 foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet of the system, shall have been submitted to a test of less than a 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts. The system shall then be tight at all points.

3.6 TESTING ON STORM WATER PIPING WITHIN THE BUILDING

- A. Storm drainage systems within a building shall be tested in accordance with the same requirements as drainage and vent piping. The contractor may test the piping with compressed air or with standing water, at his discretion.

3.7 TESTING OF POTABLE WATER PIPING

- A. General Procedures:
 1. Furnish all required personnel and equipment and make all tests required to receive the approval of the Architect/ Engineer and all agencies having jurisdiction, including the Michigan Department of Consumer and Industry Services Plumbing Code, incorporating the 2015 Edition of the International Plumbing Code. Where the requirements of this specification are more stringent than those of the agencies listed, the testing requirements specified herein shall apply.
 2. Use Piping Pressure Test Form for record purposes where applicable.
 3. Inspectors representing the Owner shall have access at all times to all portions of the piping systems. The Contractor shall make reasonable provisions to enable the inspectors such access.
 4. All tests shall be witnessed by an inspector representing the Owner. The inspector shall be a representative from the Architect/Engineer's office or, with prior approval, a representative from the Construction Manager's field office.
 5. The Contractor shall take every precaution during testing to ensure the safety of the operating personnel. Systems to be pressurized shall be provided with appropriate gauges and pressure relieving devices.
 6. Prior to every test the piping systems shall be visually inspected to assure that there are no visual defects and that all connections appear to be tight.
 7. All joints, including welds, shall be left un-insulated, unpainted, and exposed for examination prior to and during testing.

8. As far as is practicable, all pressure tests shall be complete system tests. Where project conditions and/or schedule necessitate, pipe shall be tested in sections. No pipe or joint shall be untested.
9. Tested systems shall not exceed allowable pressure loss for 24 hours.
10. Where any work or installation does not pass the initial test, the necessary corrections shall be made to comply with the requirements. Retesting of lines after repairs shall be done in conformance with the original testing requirements.
11. Water Supply System Test
 - a. Water supply systems shall be tested under a water pressure equal to 50% greater than the system operating pressure or 50 psig, whichever is greater. The system operating pressure is defined as the static pressure at a nearby hydrant, as tested by local water authority. The static pressure test data used shall be the most recent available. If no static pressure tests are available, or if the local water authority determines that the most recent test may not be reliable, the Contractor shall request a new test. System testing shall not commence until reliable system static pressure data is available.
 - b. All test pressures shall be maintained for a minimum of ten minutes before visual examination of joints begins.
 - c. Hydrostatic test pressures shall not be applied until the piping system and the testing medium have reached thermal equilibrium.
 - d. Equipment that is not to be subjected to the pressure test shall be either disconnected from the piping or isolated by blinds or other means during the test. Valves may be used provided that the valves are suitable for the proposed test pressure.
 - e. Expansion joints shall be provided with temporary restraint, if required, for the additional pressure load under test, or shall be isolated from the test.
 - f. Control devices, air vents, instruments, pressure relief and thermal relief valves shall be excluded from the test.
 - g. Lines that are spring or counterweight supported and all vapor or gas lines shall be temporarily supported during the test in order to support the test fluid load, if necessary.
 - h. Lines containing check valves shall have the pressure applied upstream of the check valve so that pressure is applied under the seat.
 - i. Caulking of screwed joints or peening of welds to repair non-compliant piping is not permitted. In the event leakage occurs, pipe shall be dismantled, re-threaded or re-welded and new fittings shall be installed.
 - j. Hydrostatic test pressures for fiberglass reinforced plastic, glass or plastic pipe, must not exceed manufacturer's recommended working pressure.
 - k. During the tests, hydrostatic pressures shall be monitored and corrections shall be made to compensate for thermal expansion or contraction. By this procedure the test pressure shall be kept within five (5) psig or one percent, whichever is greater, of its intended value.
 - l. Tested systems shall be vented and drained immediately upon successful completion of the test. All process and solvent lines shall be dried by passing clean dry oil-free air through them until they are dried to the satisfaction of the Architect/Engineer or his representative.
12. Test Reports:
 - a. The Contractor shall make a record of the test applied to each piping system, which shall consist of the following data:
 - b. Line designation number.
 - c. Date of test.
 - d. Type of test, pressure applied, and length of time at test pressure.

- e. Tested by:
- f. Comments, if any:
- g. Piping Pressure Test Report (attached) to be completed.

3.8 APPLICATION

- A. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- B. Install globe valves for throttling, bypass, or manual flow control services.
- C. Provide flow controls in water recirculating systems where indicated.

3.9 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Chlorinate only when the buildings are unoccupied and before water is used for human consumption. Post signs at all taps stating water is unsafe; remove signs after chlorination.
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.10 POTABLE WATER SYSTEM LEAD TESTING

- A. After completion of the work and prior to owner occupancy, contractor shall utilize the services of an independent testing laboratory to verify that concentrations of dissolved lead in the potable water system meet the guidelines of US EPA and State and local Health Departments.
- B. Testing shall include representative sampling from all areas of the building, typically sampling the incoming water, at the end of each major piping supply loop, and at domestic hot water returns to water heater systems. Testing shall sample the first ½ gallon at each location after systems have been idle for at least 6 hours.

3.11 CLOSING IN UNINSPECTED WORK

- A. General: Do not cover up or enclose work until it has been properly and completely tested, inspected, and approved.

- B. Non-Compliance: Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required and, after it has been completely inspected and approved, make all repairs and replacements with such materials as are necessary to the approval of the Architect/Engineer and at no additional cost to the Owner.

3.12 CLEANING UP

- A. Prior to acceptance of the work, thoroughly clean all exposed portions of the plumbing installation, removing all labels and all traces of foreign substance, using only a cleaning solution approved by the manufacturer of the plumbing item and being careful to avoid all damage to finished surfaces.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

1 GENERAL

1.1 SECTION INCLUDES

- A. Gas-Fired Instantaneous Water Heaters

1.2 REFERENCE STANDARDS

- A. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.
- B. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- C. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittals procedures.
- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate equipment dimensions, size of tappings, performance data, and gas/electric requirements (if any).

1.4 CERTIFICATIONS

- A. Water Heaters: NSF approved.
- B. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable, in addition to requirements specified elsewhere.
- C. Electric Water Heaters: UL listed and labeled to UL 174 or UL 1453.
- D. Pressure Vessels for Heat Exchangers: ASME labeled, to ASME (BPV VIII, 1).
- E. Water Tanks: ASME labeled, to ASME (BPV VIII, 1).
- F. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2 PRODUCTS

2.1 GAS-FIRED INSTANTANEOUS COMBINATION DOMESTIC AND HEATING HOT WATER BOILER.

- A. Manufacturers:
 - 1. Lochinvar
 - 2. Navien
 - 3. Rinnai
 - 4. All others by Voluntary Alternate.
- B. General: cold-rolled carbon steel powder-coated casing, shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and the minimum efficiency

requirements of the latest edition of the ASHRAE 103 Standard.ANSI Z21.13 /CSA4.9

- C. Heat Exchanges: fully welded, vertical water-tube, 316 Stainless steel primary and secondary heat exchanger. an internal brazed plat heat exchanger, diverter valve and pump for domestic hot water production.
- D. Burner: 10:1 turn-down, fully modulating, natural gas. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates.
- E. Controls: the combination boiler shall feature the “smart control” control with a graphic electronic lcd display with password security, setpoint with outdoor air reset curve, pump delay with freeze protection, pump exercise, domestic hot water prioritization, combi preheat and domestic hot water response mode. the combination boiler shall have the capability to limit the heating btu’s produced by the boiler, space heat limiting. the boiler shall have a built-in “cascade” for space heat operation. supply voltage shall be 120 volt / 60 hertz / single phase.
- F. Venting: Direct Vent Vertical system with a vertical roof top termination of both the vent and combustion air.
- G. Efficiency: 95%, 0.95 UEF.
- H. Venting: 2” or 3” schedule 40 PVC.
- I. Warranty: 10-year heat exchanger, 5-year parts.
- J. ANSI Z21.10.3, NSF 5, AHRI listed.
- K. Accessories: Integral recirculation pump, or external recirculation pump as note on Schedule and Plans. Include diaphragm tank and
- L. ASSE mixing valve – separately See Schedules.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. A.O. Smith.
 - 2. Amtrol Inc.
 - 3. ITT Bell & Gossett.
 - 4. Taco Corporation.
- B. Construction: Potable, FDA approved, welded steel, tested and stamped in accordance with ASME (BPV VIII, 1) as scheduled; 125 psig, with flexible heavy duty butyl ANSI/NSF 61 diaphragm sealed into tank, and steel legs or saddles.
- C. Tank shall include polypropylene liner, lifting lugs, floor-mount vertical or suspended horizontal installation as shown on plans and/or scheduled.
- D. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to match system static pressure.
- E. Size and Model: See Schedules for sizes and ASME rating requirement.

2.3 DOMESTIC RECIRCULATION PUMPS

- A. Manufacturers:
 - 1. ITT Bell & Gossett.
 - 2. Armstrong Pumps Inc.
 - 3. Taco, Inc.

- B. Bronze-fitted, NSF, for potable water use, with programmable timer, flow-switch, or combination timer and flow switch controls as scheduled.
- C. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
- D. Impeller: Bronze.
- E. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- F. Seal: Carbon rotating against a stationary ceramic or silicon carbide face.
- G. Drive: Flexible coupling.
- H. Permanently oil lubricated.
- I. Refer to Plumbing drawings for details.

3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping, gas venting, and electrical work to achieve operating system.
- C. Incorporate mixing valve and specialties indicated elsewhere in the specifications.
- D. Startup Service
 - 1. Engage a factory-authorized service representative to perform the following startup service:
 - a. Complete installation and startup checks according to manufacturer's written instructions.
 - b. Check piping connections for tightness.
 - c. Clean strainers if any.
 - d. Verify that pump controls are correct for required application.
 - 2. Perform the following startup checks for each pump of packaged booster pump unit before starting:
 - a. Verify bearing lubrication.
 - b. Prime pumps by opening suction valves and closing discharge valves, and prepare pumps for operation.
 - c. Start motors.
 - d. Open discharge valves slowly.
 - e. Adjust settings.
 - 3. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting packaged booster pumps to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
 - 4. Labeling and Identification: Install identifying equipment markers and equipment signs on booster pumps.
 - 5. Demonstration: Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged booster pumps. Refer to Division 01 Section "Demonstration and Training".
- E. Domestic Water Heaters: Install level and plumb on concrete base and maintain manufacturer's recommended clearances.

F. Pumps:

1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
2. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
3. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

1 GENERAL

1.1 SECTION INCLUDES

- A. Water closets.
- B. Urinals
- C. Lavatory sink.
- D. Commercial kitchen sinks.
- E. Mop Service Basins.
- F. Drinking Fountains.
- G. Supplies, Traps, and Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers: Seal fixtures to walls and floors.
- B. Section 22 10 05 - Plumbing Piping.
- C. Section 22 30 00 - Plumbing Equipment.

1.3 REFERENCE STANDARDS

- A. Plumbing fixtures and fittings shall comply with the following applicable standards and requirements:
- B. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers; 1997 (Reaffirmed 2002).
- C. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2005 (or most current).
- D. ASME A112.19.2 - Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals; The American Society of Mechanical Engineers; 2008. (or most current).
- E. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use); The American Society of Mechanical Engineers; 2008. (or most current).
- F. ASME A112.19.5 – Trim for Water-closet Bowls, Tanks, and Urinals; 2005.
- G. ASME A112.19.6 – Hydraulic Performance Requirements for Water Closets and Urinals; 1995. (or most current).
- H. ANSI Z358.1 – American National Standard for Emergency Eyewash and Shower Equipment; 2004. (or most current).
- I. NSF 61 - Drinking Water System Components – Health Effects; 2007. (or most current).

1.4 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components through one source and from a single manufacturer.
 - 1. Exception: If fixtures, faucets, and components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements:
 - 1. Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
 - 2. Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- 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.

2 PRODUCTS

2.1 FLOOR-MOUNT WATER CLOSET WITH TOP SPUD HANDS-FREE FLUSH VALVE

- A. Description: floor mounted water closet, siphon jet, vitreous china closet bowl, antimicrobial ceramic, glazed trapway, 1-1/2 inch top spud, 4" no-hub, 17 inches (ADA) or 15 inches high (as Scheduled), 10 inch or 12 inch rough in, matching bolt caps, 1.6 gpf. Color: white.
 - 1. Manufacturers: Provide water closet specified, or equal by one of the following:
 - a. Sloan Valve Company.
 - b. Zurn-Elkay Company.
 - c. Kohler Co.
 - 2. Flush Valve (Flushometer) Description: flush water closet flushometer, exposed diaphragm type, non-hold open oscillating lever antimicrobial handle (Color: Green), integral screwdriver stop with vandal resistant stop cap, synthetic rubber diaphragm, vacuum breaker, sweat solder adapter with cover tube and cast set screw wall flange, polished chrome finish, 1.6 gpf (down), hands-free, 6-year battery with low battery light and manual over-ride flush button. Accessories: (2) Adhesive backed metal wall plates etched with instructions, coordinate with Architect for mounting locations.
 - a. Manufacturers: Provide flush valve (flushometer) specified, or equal by one of the following:
 - (1) Sloan Valve Company.
 - (2) Zurn Plumbing Products Group; Commercial Brass and Fixtures Operation.
 - 3. Seat Description: Bemis Model 1955SSCT, commercial heavy duty plastic toilet seat, open front, molded in bumpers, self-sustaining hinge, stainless steel bolts, without cover. Color: white.
 - a. Manufacturers: Provide toilet seat specified, or equal by one of the following:
 - (1) Bemis Manufacturing Company.
 - (2) Church Seats.

(3) Zurn Plumbing Products Group; Commercial Brass and Fixtures Operation.

2.2 WALL-MOUNT WATER CLOSETS WITH TOP SPUD HANDS-FREE FLUSH VALVE

- B. Description: wall-mounted water closet, siphon jet, vitreous china closet bowl, antimicrobial ceramic, glazed trapway, top spud, 4" no-hub (see carrier requirements below) 17 inches (ADA) or 15 inches high (as Scheduled and noted on plans), 750 lbs rating, Color: white.
1. Manufacturers: Provide water closet specified, or equal by one of the following:
 - a. Sloan Valve Company.
 - b. Zurn Plumbing Products Group.
 2. Flush Valve (Flushometer) Description: flush water closet flushometer, exposed diaphragm type, non-hold open oscillating lever antimicrobial handle (Color: Green), integral screwdriver stop with vandal resistant stop cap, synthetic rubber diaphragm, vacuum breaker, sweat solder adapter with cover tube and cast set screw wall flange, polished chrome finish, 1.6 gpf/1.1 gpf dual-flush, hands-free, hard-wired with manual over-ride flush button. Accessories: (2) Adhesive backed metal wall plates etched with instructions, coordinate with Architect for mounting locations Manufacturers:
 - (1) Sloan Valve Company.
 - (2) Zurn Plumbing Products Group; Commercial Brass and Fixtures Operation.
 3. Seat Description: commercial heavy duty, injection molded, plastic toilet seat, open front, molded in bumpers, self-sustaining hinge, stainless steel bolts, without cover. Color: white.
 - a. Manufacturers: Provide toilet seat specified, or equal by one of the following:
 - (1) Bemis Manufacturing Company.
 - (2) Church Seats.
 - (3) Zurn Plumbing Products Group; Commercial Brass and Fixtures Operation.
 4. Water Closet Carrier Description: Extra heavy duty, 750 lbs. rating, wall carrier, dura-coat finish, right or left hand main fitting, 2" vent connection, adjustable gasketed faceplate, floor mounted foot supports, 4" cast iron no-hub connection, rear anchor tie, fixture bolts, trim, and stud protectors, ASME A112.6.1M.
 - a. Manufacturers: Provide urinal carrier specified, or equal by one of the following:
 - (1) Jay R. Smith Manufacturing Company.
 - (2) Zurn Plumbing Products Group; Specification Drainage Operation.

2.3 WALL MOUNT URINAL WITH HANDS-FREE FLUSH VALVE

- A. Description wall hung urinal, washout, vitreous china, top-spud flush valve, 0.25 gpf, 2 inch outlet (NPTF). Color: white.
1. Manufacturers:
 - a. Sloan Valve Company.
 - b. Zurn Plumbing Products Group.
 2. Flush Valve (Flushometer) Description: top-spud, high efficiency, quiet diaphragm, urinal flushometer valve, 0.125 GPF; hands-free hard-wired, control stop, vacuum breaker, internal seals, adjustable tail-piece, spud coupling with top spud connection.

- a. Manufacturers: Provide flush valve (flushometer) specified, or equal by one of the following:
 - (1) Sloan Valve Company
 - (2) Zurn Plumbing Products Group.
- 3. Urinal Carrier Description: plate type wall carrier with bearing plates with steel uprights, welded feet, dura coated cast iron.
 - a. Manufacturers: Provide urinal carrier specified, or equal by one of the following:
 - (1) Jay R. Smith Manufacturing Company.
 - (2) Zurn Plumbing Products Group; Specification Drainage Operation.

2.4 LAVATORY SINKS

- A. Seamless, one-piece Terreon composite, front overflow, single center hole integral faucet with right-hand single-hole soap dispenser, drain located near back of bowl, dimensions as Scheduled. Color: provide standard finish color swatch. Install per Barrier Free and ADA requirements.
 - 1. Manufacturers: Provide lavatory specified, or equal by one of the following:
 - a. Bradley Corp.
 - b. All others by Voluntary Alternate.
 - 2. Faucet & Soap Dispenser Description: Accessory to Bradley lavatory sink described above. Provide architect finish options. See Schedule
- B. Undermount, oval, lavatory sink, vitreous china, self-rimming, front overflow, as Scheduled. Color: white (provide standard color swatch for Architect approval. Install per Barrier Free and ADA requirements.
 - 1. Manufacturers: Provide lavatory specified, or equal by one of the following:
 - a. Kohler Company.
 - b. American Standard.
 - c. Sloan Company.
 - 2. Faucet with Soap Dispenser Description: Same as above, Bradley to match those Scheduled – see above.
 - 3. Accessories:
 - a. If exposed only Chrome plated 17 gage brass 1-1/4 P-trap with cleanout, cast brass nuts, and arm with escutcheon. If not exposed standard PVC may be used ---field verify with installation.
 - b. Rigid Supplies: NPS 1/2 inch soldered or threaded copper connection to supply, NPS 3/8 inch chrome plated brass angled stops with quarter turn on/off operation, blow out proof stem and chrome plated metal die cast handle (no plastic), chrome plated rigid copper risers upstream of mixing valve, chrome plated rigid copper risers or stainless steel flexible supplies downstream of mixing valve.
 - c. Individual mixing valve, ASSE 1070, refer to specification section 221006. Securely attach to wall to ensure rigid installation. Set discharge temperature at 110 F.

- d. Lavatory trim insulation.

2.5 SINKS

- A. Three-compartment commercial food service sink, 16 gauge type 304 stainless, 94"x29-13/16"x44-3/4" with 14" deep bowls, 9" back-splash, 18" left and right drain boards, 8" center set sidewall 3-hole faucet rough, stainless steel tubular legs.
 - 1. Manufacturers: Provide sink specified, or equal by one of the following:
 - a. Elkay Manufacturing Company.
 - b. Just Manufacturing Company.
 - c. Kohler Company.
 - 2. Sidewall mounted 12" tubular swing spout with stainless steel flexible hose pre-rinse sprayer, flat-blade lever handles, solid brass body, 8 inch centerset, 1/2 inch IPS adapters, 2.0 gpm. Finish: Polished chrome.
 - a. Provide faucet specified, or equal by one of the following:
 - (1) Chicago Faucets.
 - (2) Delta Faucet Company.
 - (3) T&S Brass.
 - 3. Accessories:
 - a. Removable grid-drains,
 - b. Manual drain valves (total of 3).

2.7 MOP SERVICE BASINS

- A. Flush to wall, one piece cast polymer floor mount mop service basin with stainless steel dome strainer, 24 inch by 24 inch by 10 inch high outside dimensions. Color: White.
 - 1. Manufacturers: Provide mop service basin and accessories as specified, or equal by one of the following:
 - a. Mustee E.L & Sons Inc.
 - b. Crane Plumbing, LLC/Fiat Products.
 - c. Fiat Company.
 - 2. With wall mounted service sink faucet with integral stops, lever handles vacuum breaker spout, hose thread outlet, wall brace, and pail hook. Finish: Rough chrome.
 - a. Provide faucet specified, or equal by one of the following:
 - (1) As accessory to mop sink manufacturer.
 - (2) American Standard Inc.
 - (3) Chicago Faucets.
 - (4) T & S Brass and Bronze Works, Inc.
 - (5) Zurn Plumbing Products Group.
 - 3. Accessories:

- a. Hose and hose bracket.
- b. Mop hanger.
- c. Vinyl bumper guards (2 required).

2.8 DRINKING FOUNTAINS

- A. Outdoor, upper bottle filling station, tri-level pedestal, non-filtered, non-refrigerated, drinking fountain. 316 stainless steel, heavy duty vandal-resistant, laminar flow. Mechanical front bubbler activation, Lead-free NSF/ANSI 61 / 372, ADA. Powder-coated enamel pain (provide standard color swatch for Architect.)
 - 1. Provide Drinking Fountain specified or equal by one of the following:
 - a. Elkay Company.
 - b. Acorn Engineering Company.
 - c. Willoughby Industries.
 - 2. Accessories:
 - a. Direct-bury adapter for underground PEX tubing piping.
 - b. Contractor to provide PVC sleeve for drain-down and underground PEX connection for freezeless installation.
 - c. Contractor (in coordination w/ supplier) to provide complete for installation.

2.11 SUPPLIES, TRAPS & ACCESSORIES

- A. Manufacturers: Provide supplies traps and accessories by one of the following:
 - 1. BrassCraft Manufacturing Co.
 - 2. Keeney Manufacturing Co.
 - 3. McGuire Manufacturing Co.
 - 4. Watts Industries, Inc.; Water Products Div.
 - 5. Zurn Plumbing Products Group; Commercial Brass Operation
- B. Supplies: Provide shutoff valves or stops at all fixtures. Use 1/4-turn ball valves, as shutoff valves, gate valves are not acceptable. Note: All stops shall utilize threaded or sweat connections on supply side (inlet to stop). No compression fittings are allowed on the inlet side to the stop. Supply kits for lavatories and water closets shall include commercial grade chrome plated brass stops with brass stems and handles. No plastic stems or handles. Include chrome plated copper risers. Stainless steel flexible supplies as manufactured by Watts or Brasscraft are allowed where indicated (flexible supplies are not allowed upstream of individual mixing valves – no exceptions). Inlet and outlet sizes for all supplies shall be 3/8 inch or 1/2 inch as needed. Supply kit shall be certified by a recognized testing authority, and marked with the manufacturer's name.
- C. P-Traps: Lavatory and sink p-traps shall be chrome plated cast brass with cleanout, 17-gauge seamless brass adjustable wall bend, cast brass slip nuts and no reducing washers. Traps shall have shallow flange and minimum of 2 inch water seal. 1-1/4 inch size for lavatories and 1-1/2 inch size for sinks. Trap shall be certified by a recognized testing authority and stamped with such insignia, and marked with the manufacturer's name clearly legible for inspection. For barrier free fixtures, utilize typical offset configured drain if fixture does not meet ADA requirements.
- D. Grid Drain: Grid drains for lavatories shall be 1-1/4 inch or 1-1/2 inch chrome plated cast brass

strainer, open grid style with brass lock nut. Drain tailpiece shall be 17-gauge seamless brass tube and minimum of 6 inches long. Grid drain shall be certified by a recognized testing authority and marked with the manufacturer's name.

- E. Lavatory Trim Insulation: All exposed lavatory and sink trim on barrier free fixtures shall be protected with a anti-microbial white vinyl insulating outer shell. Material shall be flame retardant and fungal and bacterial resistant. Insulating kits shall include covers for drain tailpiece, all p-trap components, and all hot and cold water supplies including mixing valve.
 - 1. Insulation shall be by one of the following:
 - a. McGuire Manufacturing Co. "Pro-Wrap".
 - b. Plumberex Specialty Products, Inc. "Pro-Extreme" series.
 - c. TRUEBRO, Inc. "Lav-Guard".

3 EXECUTION

3.1 EXAMINATION

- A. Confirm that millwork, cabinets, counters, walls, and floors are constructed with adequate provision for the installation of fixtures.
- B. Verify roughing in of sanitary drain and vent and water supply systems and actual locations of piping connections before installation of plumbing fixtures.
- C. Proceed with the installation of fixtures after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in/minimum size connection schedule on drawings, but in no case smaller than required by the Michigan Plumbing Code 2018.

3.3 INSTALLATION

- A. Install components level and plumb.
- B. Install and secure fixtures in place with wall carriers and bolts.
- C. Install counter mounting fixtures in and attached to casework.
- D. Install fixtures plumb and level in accordance with rough in drawings.
- E. Install drain piping with trap on outlet of each fixture to be connected to the sanitary drainage system. (Traps not required on fixtures with integral traps or indirectly connected to the sanitary drainage system, unless indicated otherwise).
- F. Install water supplies to each fixture connected to water distribution system with stop on each supply, attach supplies to substrate or supports behind fixtures within pipe spaces.
- G. Install flush valves (flushometer) for accessible water closets with lever handle on wide side of compartment.
- H. Install tank type water closets with lever handle on wide side of compartment.
- I. Install toilet seats on water closets.
- J. Install trap cartridges or trap seal liquid in waterless urinals.
- K. Install faucets and fixture fittings with flow rates as specified.
- L. Install showers with flow rates as specified.

- M. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 05, color to match fixture. Manufacturer's recommended hold down bolts shall be used and shall be equipped with nuts and washers.
- N. Install flushometer valves for accessible water closets with handle mounted on the wide side of the compartment.
- O. Traps, Strainers and Supplies shall rough in full to connections. Adapter extensions are not allowed.
- P. Install disposer in outlet of each sink indicated to have disposer. Install switch as indicated or in wall adjacent to sink if no location is indicated.
- Q. Install dishwasher discharge into wye branch fitting on sink tailpiece or dishwasher connection on disposer and securely fasten to underside of counter; or install dishwasher air gap fitting in sink deck and connect inlet hose to dishwasher and outlet hose to wye branch fitting or dishwasher connection on disposer.
- R. Set mop service basins, bathtubs, and shower receptors in leveling bed of cement grout.
- S. Assemble plumbing fixtures, fittings, trim, and components according to manufacturers' written instructions.
- T. Roughing in dimensions shall be determined only from fixture submittals approved by the Architect/Engineer.
- U. Mounting of fixtures shall meet ADA/Barrier Free requirements where applicable.
- V. The rims, fronts and all exposed parts of lavatories, service sinks, water closets, drinking fountains and other fixtures shall be covered and protected with suitable guards and building paper until completion of the work. This protection is to be installed immediately at the time of setting plumbing fixtures and to be removed only when the completed project is turned over to the Owner.

3.4 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Operate and adjust faucets and controls. Replace malfunctioning or damaged fixtures, fittings, and controls.
- C. Operate and adjust disposers and controls. Replace malfunctioning or damaged units.
- D. Install fresh batteries in sensor operated flushometer valves and faucets.
- E. Replace washers and seals of dripping or leaking faucets and stops.
- F. Clean plumbing fixtures, faucet, and fittings with manufacturers recommended cleaning instructions; remove faucet strainers, remove debris and sediment, and reinstall clean strainers; remove debris and sediment from drains. Inspect all plumbing fixtures after installation and cleaning is complete, and repair or replace damaged fixtures or finishes as required to restore to new factory condition.

END OF SECTION

SECTION 23 00 00
HEATING, VENTILATION, AND AIR-CONDITIONING (HVAC)

PART 1 GENERAL REQUIREMENTS

1.1 GENERAL

- A. This Division includes specifications required for installation, testing, operation, and warranty of mechanical HVAC and related mechanical work.
- B. The work shall also include any items which, while not specifically included in the Contract Documents but are reasonable and are accepted trade practices or necessary for the proper completion of the systems.
- C. Mechanical systems described herein and indicated on the Drawings are intended to supplement each other. The better quality or greater quantity of work shall be provided by the Contractor.
- D. Equipment, ductwork, piping, etc., must be installed as shown on the Drawings, or in a reasonable, neat, and professional manner to limit conflicts with other materials, and provide adequate access and service space. Note special smoke purge system requirements, and associated temperature control system requirements, and coordination with the fire control system, and fire control system contractor.
- E. Mechanical systems in the Contract shall include all systems described herein and on the Drawings.
- F. The Mechanical Contractor shall acquire all necessary permits and inspections required by State and Local jurisdictions.
- G. The General Provisions of this Contract, including General and Supplementary Conditions and other General Requirements Sections, apply to the Work specified in this Section.
- H. This Section is not intended to supersede, but to clarify the definitions and requirements described in the preceding and following specifications.
- I. The Contractor shall review the Specifications and Drawings of other Trades, and coordinate all work.
- J. The Contractor is responsible for contacting the Engineer regarding questions or conflicts within the Specifications, Drawings, or design described within the Construction Documents, during the bidding process, prior to submitting bids. Post-bid consideration for claims or extras will be at the discretion of the Engineer and Owner.
- K. The Mechanical Contractor must subcontract a third-party Test and Balance Contractor to perform independent testing and balancing of all new waterside and airside systems.
- L. Nomenclature and Abbreviations:
 - 1. Spicer Group herein shall be referred to as the Engineer.
 - 2. The Mechanical Contractor herein may be referred to as the MC.
 - 3. The Temperature Control Contractor herein may be referred to as the TCC.
 - 4. The Fire Alarm Panel (if applicable) Herein may be referred to as FAP.
 - 5. The Fire Alarm Panel Contractor may be referred to as the FAPC.
 - 6. The Test and Balance Contractor may be referred to as the TAB Contractor.

1.2 MECHANICAL WORK

- A. Responsibility:

1. The Mechanical Contractor shall be responsible for all Subcontractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local regulations, jurisdictional awards, and decisions and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.
 2. The Mechanical Contractor and Subcontractor shall be responsible for all parts applicable to his trade in accordance with the Specifications and Drawings, and shall be responsible for coordinating locations and arrangements of his work with all other relevant Architectural, Structural and Electrical Contractor's Specifications, Drawings and Shop Drawings.
- B. Site and Project Document Examination:
1. Submission of a Bid Proposal is considered evidence that the Contractor has visited the site, examined the Drawing and Specifications of all trades and has fully informed himself as to project and site conditions and is proficient, experienced and knowledgeable of all state, local and federal standards, codes, ordinances, permits, and regulations which affect every Subcontractors completion, cost and time required and that all costs are included in his Bid Proposal.
- C. General Supports:
1. Mechanical Contractor shall provide all necessary channel, angle, brackets or supplementary steel as required for adequate support for all piping, specialties, and equipment, which is hung or mounted above floor, and secure approval from Architect, in writing, before welding or bolting to steel framing or anchoring to concrete structure.
 2. Where piping or equipment is suspended from concrete construction, set approved concrete inserts in formwork to receive hanger rods, such as Unistrut and where installed in metal deck use Ramset or Welds as required.
- D. Wall, Floor and Ceiling Openings:
1. Locate all openings and advise the General Contractor of details and templates of all openings necessary for inspection of mechanical work.
 2. In general, openings and required lintels shall be provided by the General Contractor. Size and location is the responsibility of the Mechanical Contractor. Cracks and rough edges left following installation of equipment shall be caulked or covered by the Mechanical Contractor.
- E. Field Changes:
1. This Contractor shall not make any field changes that effect timing, costs or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order or a Supplemental Instruction. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect as lessening the value of the project, a credit will be determined and issued as a change to the Contract.

1.3 STANDARDS, CODES AND PERMITS

- A. Refer to General Requirements and Supplementary Conditions.
- B. The Mechanical Contractor and his Subcontractors shall obtain all required permits prior to beginning work. Contractor shall include all permit and privilege fees for work required to complete the scope of work described herein, and on the Drawings.
- C. All work shall comply with the latest edition of applicable standards and codes:

Michigan Mechanical Code (MMC) -2015 Addition & International Mechanical Code - 2015
Michigan Plumbing Code (MPC) – 2018 Addition & International Plumbing Code - 2018
Michigan Building Code (MBC) – 2015 Addition – International Building Code - 2015
International Fuel Gas Code (IFGC) – 2015
ASHRAE 90.1-2013 Energy Standard for Buildings Except Low-Rise Residential Buildings
Michigan Commercial Uniform Energy Code Part 10A
Michigan Boiler Division, CSD-1 Compliance
SMACNA Sheetmetal and Air Conditioning Contractors’ National Association Standards
National Fire Protection Association (All Codes & Standards)
National Electric Code (NEC) (NFPA-70)

and:

ABMA American Boiler Manufacturers Association
AGA American Gas Association
ASA American Standards Association
ARA American Refrigeration Association
ANSI American National Standards Institute
ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers (all Standards)
ASTM American Society of Testing Materials
ASME American Society of Mechanical Engineers
AWS American Welding Society
AWWA American Water Works Association
IBR Institute of Boiler and Radiator Manufacturers
MIOSHA Michigan Occupational Safety and Health Act
NEMA National Electric Manufacturers Association
OSHA Occupational Safety and Health Act
UL Underwriters’ Laboratories

- D. Contractor must verify all code versions enacted with State and Local Authorities Having Jurisdiction (AHJ) All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.
- E. No work shall be covered or enclosed until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and submitted to Engineer before final acceptance of work.

1.4 SUBMITTALS

- A. Shop Drawings:

1. Contractor shall e-mail electronic Portable Document Format (PDF) to the Construction Manager, or General Contractor, or Engineer as requested.
 2. Submit complete manufacturers shop drawings of all equipment, accessories and controls, including capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
 3. Submittals must list equipment tags shown on Drawings, and shall use arrows, and/or circles, boxes, etc., designating exact model of equipment and accessories.
 4. Review of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under all Contract Documents, and does not approve changes in time or cost.
 5. The Contractor must include a cover sheet with stamp or electronic signature noting that he has reviewed the shop drawings prior to submitting them to the Construction Manager or Engineer.
 6. Contractor must send PDF copies of reviewed submittals to all other trades for coordination.
- B. Operating and Maintenance Instruction and Manuals:
1. Contractors and subcontractors shall provide for all major items of equipment (2) bound and indexed sets of operating and maintenance instructions, and complete set of reviewed submittals to Owner and Engineer approval.
- C. Prior to final punch list and project close-out the Contractor must provide a third-part Test and Balance Report of all air-side and water-side HVAC systems. Test and Balance Reports shall be reviewed by the Engineer for final approval.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

- A. Proposal Supplement:
1. Contractor to submit a supplemental document which lists the Mechanical Equipment and Materials Manufacturers, and Subcontractors list with the bid document.
 2. After Proposal Supplement and Subcontractors are approved, no deviation shall be permitted without written approval of Engineer or Owner.
- B. Standards:
1. All products shall be furnished by established manufacturers regularly engaged in making the type of materials to be provided and complete with all parts, accessories, connections, etc. as specified or as recommended and/or required by the manufacturer.
 2. All material where applicable shall be labeled or listed by Underwriters Laboratories, Inc.
 3. Erect equipment in a neat and workmanlike manner. Align, level and adjust for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from arrangements may be made, as approved.
- C. Base Bid:
1. The Mechanical Contractor shall refer to the Mechanical Schedules and Specifications for approved equipment manufacturers. The Base Bid shall be based on those manufacturers listed in the Schedules and Specifications only. All other manufacturers shall be by voluntary alternate bid only.
 2. Where base bid is not listed in specifications and if another manufacturer is listed as an approval equal, equipment from these manufacturers will be accepted contingent upon

meeting the design, appearance, and functional standards established by the specified items.

3. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements and is responsible for advising other Contractors of variations and shall submit revised drawing layout for approval of Engineer.

D. Substitutions and Changes:

1. The Contractor shall bid the project in strict accordance with the Plans, Schedules, and Specifications. Alternative materials or methods proposed by the Mechanical Contractor shall be submitted in writing to the Engineer at least 3 Days Prior to the Bid due date and shall be preapproved for bidding. Failure to receive pre-approval will disqualify the Bid.
2. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design is used and is responsible for advising other Contractors of variations and, if requested, submit revised drawing layout for approval of Architect.
3. Work required by Engineer to revise drawings or re-engineer mechanical systems required by equipment substituted by the Contractor or them base bid shall be paid by the Contractor to the Engineer on a hourly rate basis.

2.2 ELECTRICAL REQUIREMENTS FOR MECHANICAL WORK:

A. General:

1. When the Mechanical equipment not named as the basis of design is approved for use, the Mechanical Contractor is responsible for any costs incurred by other trades, including revisions to the Electrical requirements such as conduit, wire, starters, heaters, fused switches, disconnects, or circuit breakers.
2. Electrical items furnished shall bear the Underwriters' Laboratories label and the installation shall comply with requirements of the National Electric Code, ANSI, IPCEA, IRI, and local codes, ordinances and regulations.

B. Motor Starters and Controls:

1. Electrical Contractor shall provide all electrical equipment required for complete operation of the mechanical equipment including, circuits, fuses, VFDs, manual or magnetic motor starters, etc., unless specifically coordinated with the Mechanical Contractor.
2. Mechanical Contractor and Electrical Contractor shall coordinate and provide all necessary convenience outlets required per the MMC and NEC.

C. Temperature Controls and Wiring:

1. Mechanical Contractor or Temperature Control Contractor shall furnish, install, program, integrate, all motors, drives, controllers, front-end controllers, integral to the proper operation of equipment.
2. Mechanical Contractor or Temperature Control Contractor shall furnish and install temperature control systems as described in the Temperature Control Specification.

END OF SECTION

SECTION 23 05 23
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL REQUIREMENTS

- 1.1 MSS STANDARD COMPLIANCE: Comply with the following:
- A. Provide pipe hangers and supports on which materials, design, and manufacture comply with MSS SP-58.
 - B. Select and apply pipe hangers and supports, complying with MSS SP-69.
 - C. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
 - D. Terminology used in this section is defined in MSS SP-90. ABOVE STANDARDS ARE AVAILABLE FROM MSS (MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC.).
 - E. Regulatory Requirements: Comply with appliance plumbing codes pertaining to product materials and installation of supports and anchors.
 - F. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system.
 - G. UL and FM Compliance: Hangers, supports, and components shall be listed and labeled by UL and FM where used for fire protection piping systems.
 - H. Submittals: Submit manufacturer's technical product data, including installation instructions; shop drawings; and maintenance data for each type of support and anchor.

PART 2 PRODUCTS

- 2.1 GENERAL REQUIREMENTS:
- A. Except as otherwise indicated, provide factory-fabricated pipe hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
 - B. Horizontal-Piping Hangers and Supports:
 - C. Adjustable Steel Clevis Hangers: MSS Type 1.
 - D. Adjustable Steel Band Hangers: MSS Type 7.
 - E. Adjustable Band Hangers: MSS Type 9.
 - F. Adjustable Swivel Rings, Band Type: MSS Type 10.
- 2.2 VERTICAL-PIPING CLAMPS:
- A. Two-Bolt Riser Clamps: MSS Type 8.
 - B. Four-Bolt Riser Clamps: MSS Type 42.
- 2.3 HANGER-ROD ATTACHMENTS:
- A. Steel Turnbuckles: MSS Type 13.
 - B. Steel Clevises: MSS Type 14.
 - C. Swivel Turnbuckles: MSS Type 15.
 - D. Malleable Iron Sockets: MSS Type 16.

- E. Steel Weldless Eye Nuts: MSS Type 17.
- 2.4 BUILDING ATTACHMENTS:
- A. Concrete Inserts: MSS Type 18.
 - B. Top Beam C-Clamps: MSS Type 19.
 - C. Side Beam or Channel Clamps: MSS Type 20.
 - D. Center Beam Clamps: MSS Type 21.
 - E. Welded Beam Attachments: MSS Type 22.
 - F. C-Clamps: MSS Type 23.
 - G. Top Beam Clamps: MSS Type 25.
 - H. Side Beam Clamps: MSS Type 27.
 - I. Steel Beam Clamps W/Eye Nut: MSS Type 28.
 - J. Linked Steel Clamps W/Eye Nut: MSS Type 29.
 - K. Malleable Beam Clamps: MSS Type 30.
- 2.5 MANUFACTURER'S OF HANGERS AND SUPPORTS:
- A. B-Line Systems:
Carpenter and Patterson; Corner & Lada; Elcen Metal Products; Fee & Mason; or ITT Grinnel.
 - B. Pipe Guides:
Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
 - C. Pipe Curb Assembly:
Pipe curb assembly shall be Pate Company model PCA, or equal, (number and diameter of pipe boot penetrations to meet requirements) 18 gauge galvanized steel, unitized construction with integral base plate insulated with R-5 rigid insulation, 2 x 3 nailer, acrylic clad ABS plastic cover, fastening screws, graduated step boots with stainless steel clamps.
 - D. Rooftop Equipment Support Curbs or Rails:
Furnish where shown or required. Equal to Pate Model ES, minimum 18" high. Curbs shall be designed to support the equipment it supports on the structure as shown on plans.
 - E. Specification for Rooftop Piping and Duct Supports:
 1. Gas piping on roof surfaces may be supported by a polyethylene foam block with an integral strut channel for receiving standard strut clamps and accessories. Pipe Pier shall be installed according to manufacturer's recommendations. Roof pipe supports shall be spaced according to industry standards and shall be installed to allow for expansion and contraction. Acceptable Manufacturer: Miro Industries, Erico.
 2. Water piping on roof shall be supported by roller bearing or custom pipe hanger supports (see plans where noted). Equal to Miro Industries 10H custom pipe supports. Polycarbonate or stainless steel bases, galvanized or stainless steel strut frame assembly, stainless steel all-thread rod clevis hanger(s) or roller hangers, band hangers, or trapeze as recommended by manufacturer or engineer for installation. Load distribution maximum 3.0 psi, adjustable height, adjustable for roof slope. See plans for details and notes. Miro Industries, Erico.
 3. Ductwork on roof shall be supported by custom duct supports. Equal to Miro Industries

model 8DS. Polycarbonate or stainless steel bases, with galvanized or stainless steel strut frame assembly. . Load distribution maximum 3.0 psi, adjustable height, adjustable for roof slope. See plans for details and notes. Miro Industries, Erico.

PART 3 EXECUTION

A. Installation:

Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

D. Field-Fabricated, Heavy-Duty Steel Trapezes:

Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.

E. Support fire protection systems piping independently from other piping systems.

F. Load Distribution:

Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes:

Install hangers and supports to provide indicated pipe slopes.

H. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

I. Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

J. Comply with the following installation requirements for insulated piping:

K. Clamps:

Attach clamps, including spacers (if any), to piping with clamps protecting through insulation; do not exceed pipe stresses allowed by ANSI B31. Do not use wall mounted clamps to support exposed piping.

- L. Shields:
Install protective shields MSS Type 40 on cold water piping that has vapor barrier. Shield shall span an arc of 180 degrees.
- M. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
- N. Install anchors where not otherwise indicated, at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.
- O. Hanger Adjustment:
Adjust hangers so as to distribute loads equally on attachments.
- P. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
- Q. Installation of pipe curb assemblies and pipe seals and rooftop equipment curb or rails:
Install in strict accordance with manufacturer's written instructions.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Stickers (or Pipe Markers).

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.
- B. ASTM D 709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Air Handling Units (All types): Nameplates.
- B. Air Terminal Units: Tags.
- C. Control Panels and Equipment Controllers: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Heat Transfer Equipment: Nameplates.
- F. Major Control Components: Nameplates.
- G. Plumbing and Hydronic Piping: Pipe Stickers.
- H. Pumps: Nameplates.
- I. Ductwork: Duct Stickers or Stencils.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 3. Seton Identification Products: www.seton.com.
 - 4. Brimar Corporation: www.brimar.com
 - 5. Substitutions: See Product Requirements.
 - 6. Letter Color: White.
 - 7. Letter Height: 1/4 inch (6 mm).
 - 8. Background Color: Black.
 - 9. Plastic: Conform to ASTM D 709.

2.3 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
 - 2. Brady Corporation: www.bradycorp.com.
 - 3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 4. Seton Identification Products: www.seton.com.
 - 5. Brimar Corporation: www.brimar.com

- 6. Substitutions: Approved meeting this description and approved shop drawings.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.4 STENCILS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 3. Seton Identification Products: www.seton.com.
 - 4. Substitutions: Approved meeting this specification and approved shop drawings.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
 - 2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
 - 3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

2.5 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 3. Seton Identification Products: www.seton.com.
- B. Substitutions: Approved meeting this specification and approved shop drawings.
Color: Conform to ASME A13.1.
- C. Pipe Stickers: Flexible, vinyl film, with heavy-coated, adhesive-backed, pipe markers. -20F to 200F, ANSI / ASME A13.1 2015.
- D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.6 CEILING TACKS

- A. Description: Steel with 3/4-inch (20 mm) diameter color coded head.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section stencil painting.

3.2 INSTALLATION

- A. Install new Unit Ventilators, Air Handler Nameplates (matching new naming convention), boilers, and boiler pumps (as noted on new plans), and tag as shown on Drawings. All existing AHUs and new and existing UVs equipment shall be tagged using the room number where the thermostat is installed. The single new AHU pump shall follow the AHU naming convention as noted.
- B. Install new pipe stickers on all new boiler systems piping 2" and greater in diameter. Pipe stickers shall be sized per manufacturer recommendations for given insulated pipe diameters.

C. Tag new equipment controllers to match the equipment tags they serve.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING AND BALANCING FOR HVAC

1.0 GENERAL

1.1 RELATED DOCUMENTS

- A. Attention is directed to the Bidding and Contract Requirements which are hereby made a part of this section.
- B. All applicable provisions of description of work and other sections of these specifications are to be adhered to.

1.2 QUALIFICATIONS

- A. Test and Balance (TAB) Contractors shall be current members in good standing of AABC, NEBB and SMACNA. They shall be responsible for providing all testing and balancing equipment and that equipment shall be certified to be currently recalibrated to optimal accuracy.
- B. The TAB Contractor must be independent of the Mechanical Contractor or other Contractors hired to perform work on this project.
- C. Contractors shall have a minimum of ten (10) years of documented test and balance experience.

Approved Test and Balance Contractors:

- 1. Enviro-Aire
28915 Harper Ave.
St Clair Shores
MI. 48081-1271
586-779-6200
Paul Cornett, John Kermizian
- 2. International Test and Balance
17135 W 10 Mile Rd. #112
Southfield, MI. 48075
248-559-5864
Craig Dow
- 3. Integrity Test and Balance
11448 S. Ramblewood Drive
Cedar, MI. 49621
231-929-0940
Kevin Heikkila
- 4. Hi-tech Test and Balance
10765 Geddes Rd.
Freeland, MI. 48623
989-695-5498
Bill Haire

1.3 TEST AND BALANCE WORK SCOPE

- A. The TAB Contractor must test and balance the following systems:
 - 1. All air-side equipment (RTUs, Exhaust Fans, etc.).
 - 2. Air grilles, registers, and diffusers (GRDs).

1.4 TEST AND BALANCE CONTRACTOR AND ENGINEER COORDINATION AND COMMUNICATION.

- A. The TAB Contractor must communicate system malfunctions and the inability to balance systems at the time of testing.
- B. The TAB Contractor may include extra test and balance time and fee to include this communication and coordination service.
- C. The TAB Contractor must work with the Contractor and Engineer to solve TAB issue, “in real time”, during the TAB process.
- D. The TAB Contractor and Mechanical Contractor is required to contact the Spicer Group Engineer, Aaron Wosek 231-645-5992, if any of the following takes place during the TAB process:
 - 1. Equipment is malfunctioning.
 - 2. Motor sizes are incorrect.
 - 3. Equipment and grilles, registers, and diffuser sizes vary from the drawings.
 - 4. Balance dampers of circuit setters are not where shown on the plans, schematics, and details, or where needed to properly balance.
 - 5. Grilles, registers, or diffuser airflow rates cannot be balanced within +/- 10% of the required flowrate.
 - 6. Supply and return water flow cannot be balanced to within the +/- 10% of the required flowrate.
 - 7. Excessive system noise.
 - 8. Unsealed ductwork.
 - 9. Violations of Code.
 - 10. Other notable system defects or concerns.
- E. Failure to communicate system TAB malfunctions with the Engineer during the TAB process may result in requiring the TAB Contractor to perform additional unpaid site visits.
- F. The final test and balance report must not report systems that fall outside the +/-10% acceptable test and balance range without authorization from the Engineer.

2.0 REPORTS

- A. General: Submit testing, adjusting, and balancing reports bearing the seal and signature of the test and balance engineer or the signature and list of qualifications of a test and balance technician. The reports shall be proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
- B. Report Format and Contents
 - 1. Format: Bind report forms in three-ring binders or portfolio binders. Label edge and binder front cover with label identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions, separated by divider tabs:
 - 2. Report Tags and Labels: Use equipment tags and labels (for example: AHU-XXXX, RTU-XXXX, B-X, P-XX, etc.) as listed on the Mechanical Drawings, when labeling report equipment.

General Information:

- a. Summary and Title Page
- b. Air Systems
- c. Water Systems
- d. Special Systems

Title Page:

- a. Company name
- b. Company address
- c. Company telephone number
- d. Name, signature, and registration number of each technician
- e. Project name
- f. Project location
- g. Project Engineer
- h. Project Contractor
- i. Date of report
- j. Balancing methodology

Instrument List:

- a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial number
 - e. Range
 - f. Calibration histories
3. Report Data: The remainder of the report shall contain the appropriate forms for each respective item and system. Fill out forms completely. Indicate on form when information cannot be obtained or is not applicable.
 4. Air Systems: For air systems, the forms shall, at a minimum, include:
 - a. Names and initials of personnel performing the balancing (on each form)
 - b. Dates balancing was performed (on each form)
 - c. Weather conditions at the time of the test (especially temperature)
 - d. All motor rated data: voltages, amps, RPM, HP, manufacturer, starter and overload protective device sizes
 - e. All motor operating data (before and after adjustments) voltages, amps, RPM, HP, BHP, and sheave size/rating and manufacturer
 - g. All fan data (design and operating): supply and return CFM, operating static pressures (suction, discharge, and fan static), fan sheave, belt size, fan RPM
 - h. All drive changes necessitated to obtain design capacities
 - i. List actual minimum outside air volumes measured for each system and the corresponding control setpoint

- j. All supply and return air outlet airflow (CFM) readings. Include velocity measurements and A_K factors where applicable. Include initial and final CFM readings at each box.
 - k. For VAV systems, record static pressure at each terminal box as well as static pressure at static pressure sensor (for temperature control system).
 - l. Measure building static pressure at building static pressure sensor and five other locations.
 - m. Heating and cooling coil entering and leaving air temperatures during test (as a reference).
 - o. See Test and Balance Appendix #1 provided below for air systems testing points.
5. Water Systems (if applicable): For water systems, the forms shall, at a minimum, include:
- a. Names and initials of personnel performing the balancing (on each form)
 - b. Dates balancing was performed (on each form)
 - c. All motor operating data (design and operating): voltages, amps, RPM, HP, BHP, starter and overload protective device sizes/rating
 - d. All pump data (design and operating): GPM, RPM, discharge pressure (no flow and full flow), suction pressure (no flow and full flow), total head pressure (no flow and full flow), impeller size, (ensure that pump curves are in O&M manuals)
 - e. Flow levels for each unit served (design and operating)
 - f. Heating and cooling coil water entering and leaving temperatures
 - g. See Test and Balance Appendix #1 provided below for water systems testing points.
6. Test and Balance Summary
- a. Provide sheet describing mechanical system deficiencies.
 - b. Describe objectionable noise or drafts found during testing, adjusting and balancing.
 - c. Provide recommendations for correcting deficiencies and unsatisfactory performances and indicate whether modifications required are: within the scope of the contract; design related; or installation related.
 - d. Static pressure and CFM values at each fan system.
 - e. Static pressure and CFM values at each terminal box.
 - f. Static pressure at static pressure sensor (that ensures adequate static pressure at all terminal boxes) and at AHU static pressure sensor.
 - g. For each fan system, outside air damper position that provides required minimum outside air.
 - h. Flow rates and pressures for each hydronic system.
 - i. Pipe pressure at pressure sensor (that ensures adequate pressure at all coil valves) and at pump pressure sensor.

3.0 PRODUCTS

A. Instrumentation

1. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of Reference Standards and instrument manufacturer's specifications.
2. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments to be in accordance with the requirements of Reference Standards.
3. Provide all necessary tools, scaffolding and ladders and other necessary instruments.
4. Provide door pressure differential testing equipment to measure maximum door pressure weight required under smoke purge operation.

4.0 EXECUTION

4.1 PRELIMINARY PROCEDURES

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
 1. Equipment is operable and in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fire dampers are in place and open.
 7. Smoke dampers are in place and in the proper Normally Open or Normally Closed position as listed on the plans. Please verify the TCC has properly wired the dampers.
 8. Coil fins have been cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage has been minimized.
 12. Proper strainer baskets are clean and in place.
 13. Correct pump rotation.
 14. Correct fan rotation.
 15. Hydronic systems have been flushed, filled, and vented.
 16. Service and balance valves in water distribution system are in place and open.
 17. Operating voltage on fan and pump motors do not exceed motor's nameplate maximum voltage rating.
 18. Walk the system from the system air handling equipment to air outlets and inlets to determine variations of installation from design.
 19. Check all damper types for correct and locked position, and temperature control for completeness of installation before starting fans.
 20. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
 21. Determine best locations in main and branch ductwork for most accurate duct traverses
 22. Place outlet dampers in the full open position.
 23. Check fan belt tension.
 24. Provide sheaves and belts as needed to properly balance. Coordinate with Mechanical Contractor.
 25. Verify VFDs are included where required in the plans and Temperature Control Specifications.

- B. Beginning of work means acceptance of existing conditions.

4.2 PERFORMING TESTING, ADJUSTING AND BALANCING ON AIR SYSTEMS

- A. Perform testing, adjusting and balancing procedures on each system identified in drawing, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.
- B. In areas containing ceilings, remove ceiling tile to accomplish balancing work. Replace tile when work is complete and provide new tile for any tile that was damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner representative.
- C. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch to maintain system integrity and pressure rating of systems.
- D. In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- E. Test and Balance Contractor shall set diffuser flow rate (volume) by adjusting dampers installed on the ductwork. Do not use volume dampers that are integral with the diffusers to set volume if both duct and neck dampers are present.
- F. Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.
- G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- H. All Air Systems shall be balanced using a procedure, which results in minimum restrictions being imposed. At completion of balancing:
 - 1. At least one damper for an outlet/inlet shall be fully open on every branch duct.
 - 2. At least one branch duct balancing damper shall be fully open on every trunk duct.
 - 3. At least one trunk (zone) balancing damper shall be fully open from each Fan System.
 - 4. Supply/exhaust fan RPM shall be set so that the static pressure at the terminal that is most difficult to maintain is adequate, but not excessive.
- I. Measure and record system measurements at the fan to determine total flow. Adjust equipment as required to yield specified total flow at ventilation unit and at terminals. Proceed taking measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows after balancing branch dampers, deflectors, extractors and valves.
- J. Provide fan and motor drive sheave adjustments necessary to obtain design performance. Once drive sheave diameters have been established, replace all adjustable sheaves with solid pulleys (at Test and Balance Contractor Cost). Include in scope of services drive changes specifically noted on drawings, if any. If work indicates that any drive or motor is inadequate for the application, advise the owner representative by giving the representative properly sized motor/drive information (in accordance with manufacturers original service factor and installed motor horsepower requirements). Any changes shall keep the duct system within its design limitations with respect to the speed of the device and pressure classification of the distribution system. Material costs for sheave changes as well as time and material for motor changes will be considered a reimbursable expense and will require an itemized cost breakdown of all time and motor/drive changes submitted to owner representative; prior authorization is needed before this work is started.

- K. Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter.
- L. Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data (and test methodology). If necessary, Test and Balance Contractor should return when an adequate temperature difference between the return air and outside air temperatures exists to determine minimum outside air damper position.
- M. For systems with Demand Control Ventilation (DCV) carbon dioxide systems, set minimum outdoor air damper position to 100% closed position ---do not set to the listed minimum position as noted on the equipment Schedule.
- N. Balance modulating dampers at extreme conditions and record both sets of data. Balance variable air volume systems at maximum air flow rate (full cooling) and minimum flow rate (full heating) and record all data.
- O. Adjust register, grille and diffuser vanes and accessories to achieve proper air distribution patterns (check with Engineer for optimal configuration), uniform space temperatures, areas free from objectionable noise and drafts — that are within the capabilities of the installed system.
- P. Final air system measurements to be within the following range (unless directed otherwise by Engineer) of the specified CFM:

1. Fans	-5% to +10% of design value
2. Supply grilles, registers, diffusers	-10% to +10% of design value
3. Return/exhaust grilles, registers	-10% to +10% of design value
4. Room pressurization air	-5% to +5% of design value
- Q. Permanently mark equipment settings including damper positions, valve positions, and control settings. Set and lock memory stops.
- R. Leave systems in proper working order by replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

4.3 PERFORMING TESTING, ADJUSTING AND BALANCING ON WATER AND GLYCOL SYSTEMS

- A. Perform testing, adjusting and balancing procedures on each system identified in drawing, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.
- B. Document type and placement of expansion tank within piping system. Indicate tank water level.
- C. Document valve type and its ability to fully regulate flow during various conditions (different flow, temperature, and control conditions).
- D. Provide motor and impeller adjustments necessary to obtain design performance. Include in scope of services changes specifically noted on drawings, if any. If work indicates that any impeller or motor is inadequate for the application, advise the owner representative by giving the representative properly sized motor/impeller information (in accordance with manufacturers original service factor and installed motor horsepower/impeller requirements). Any changes shall keep the piping system within its design limitations with respect to the speed of the device and pressure classification of the distribution system. Material costs for impeller changes as well as time and material for motor changes will be considered a reimbursable expense and will require an itemized cost breakdown of all time

and motor/impeller changes submitted to owner representative; prior authorization is needed before this work is started.

- E. Measure and record pressure across pump during no flow and full flow conditions.
- F. All Hydronic Systems shall be balanced using a procedure, which results in minimum restrictions being imposed. At completion of balancing:
 - 1. At least one hydronic terminal unit balancing valve in each piping branch shall be fully open.
 - 2. At least one branch line balancing valve in each Hydronic System shall be fully open.
- G. Final water system measurements to be within the following range (unless directed otherwise by Engineer) of the specified GPM:
 - 1. Pumps -10% to +10%
 - 2. Coils, Boilers -10% to +10%
- H. Document if balancing was accomplished using valves or by trimming impeller. Document energy savings due to trimmed impeller.
- I. If parallel pumps are designed to operate together, then measure:
 - 1. Pumps at no flow
 - 2. Both pumps at full flow
 - 3. Each pump at full flow (while the other pump is off)
- J. Measure and record design and actual pressure conditions prior and after coils, chillers, and filters.
- K. Permanently mark equipment settings including valve positions, and control settings. Set and lock memory stops.
- L. Leave systems in proper working order by closing access doors and electrical boxes and systems to normal operating settings.

4.4 DEFICIENCIES

- A. When performing testing and balancing on site, report to Engineer any problems or defects with new or existing equipment, systems, or installation. Report deficiencies greater than +/- 10% of the design air and water flows. The Test and Balance Contractor is expected to solve or report in real time deficiencies greater than +/-10% when balancing. Deficiencies listed on the report that exceed +/-10% that were not previously discussed with the Engineer, may require an additional unpaid site visit by the Test and Balance Contractor.
- B. In addition to Item 4.4A above, notify the Prime Contractor and/or Mechanical Contractor (or Construction Manager, Owner's Representative, or Owner as it may apply) of any installation deficiencies found. The Mechanical Contractor is responsible for correcting all deficient work. All corrective work to be done at no cost to the owner.

4.5 COMMISSIONING

Commissioning is required by Code for all Smoke Purge System Equipment and the operation of the entirety of the building operations including door pressure differential.

- A. All testing and balancing shall perform to the satisfaction of both the Inspector(s) and Engineer prior to the acceptance of the testing and balancing report as meeting the requirements of this document.
- B. Prior to building acceptance, smoke purge system balancing data will be completely commissioned by the Test and Balance Contractor to verify compliance with this specification and satisfaction and approval by the Inspector(s) and Engineer.

- C. If the Test and Balance Contractor fails to demonstrate proper compliance with this specification, the Engineer's, Owner Representative's or Commissioning Agent's costs for witnessing and reviewing three or more spot checks will be assigned to the Test and Balance Contractor by the Owner as a deduct to their contracted price.

TEST AND BALANCE APPENDIX #1

These data collection points are for various HVAC systems and units. Some systems may not apply to this project. Data shall include, at a minimum, the following points for each HVAC system/unit.

A. Air Moving Equipment:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Model
- 5) Airflow, specified and actual
- 6) Return airflow, specified and actual
- 7) Outside airflow, specified and actual
- 8) Total static pressure (total external), specified and actual
- 9) Inlet pressure
- 10) Discharge pressure
- 11) Fan RPM

B. Exhaust Fan Data:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Model
- 5) Total static pressure (total external), specified and actual
- 6) Inlet pressure
- 7) Discharge pressure
- 8) Fan RPM, initial and final

C. Electric Motor:

- 1) Manufacturer
- 2) HP
- 3) Frame
- 4) Phase, voltage, amperage; nameplate and actual
- 5) RPM
- 6) Service factor
- 7) Starter size, rating, heater elements
- 8) Variable frequency drive balanced frequency setting (where applicable)

D. Belt Drive System:

- 1) Identification
- 2) Driven sheave, diameter
- 3) Belt, size and quantity
- 4) Motor sheave, diameter

- 5) Center to center distance, maximum, minimum, and actual
- 6) Final components

E. Duct Traverse:

- 1) System zone/branch
- 2) Duct size
- 3) Area
- 4) Design velocity
- 5) Design airflow
- 6) Test velocity
- 7) Test airflow
- 8) Duct static pressure
- 9) Air temperature
- 10) Air correction factor

F. Air Monitoring Station Data:

- 1) Identification/location
- 2) System
- 3) Size
- 4) Area
- 5) Design velocity
- 6) Design airflow
- 7) Test velocity
- 8) Test airflow

G. Air Distribution Test Sheet:

- 1) Air terminal number
- 2) Room number/location
- 3) Terminal type
- 4) Terminal size
- 5) Area factor
- 6) Design velocity
- 7) Design airflow
- 8) Test velocity, initial and final
- 9) Test airflow, final
- 10) Percent of design airflow, initial and final

H. Terminal Unit Data:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Type, constant, variable, single, dual duct
- 5) Model
- 6) Size
- 7) Minimum static pressure
- 8) Minimum design airflow
- 9) Minimum actual airflow
- 10) Maximum design airflow
- 11) Maximum actual airflow

12) Inlet static pressure

I. Induct Unit Data:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Model
- 5) Size
- 6) Design airflow
- 7) Design nozzle pressure drop
- 8) Nozzle pressure drop, initial and final
- 9) Final airflow

J. Electric Duct Heater:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Model
- 5) Design kW
- 6) Number of stages
- 7) Phase, voltage, amperage
- 8) Test voltage (each phase)
- 9) Test amperage (each phase)
- 10) Airflow, specified and actual
- 11) Temperature rise, specified and actual

K. Pump Data:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Size/Model
- 5) Impeller diameter
- 6) Service
- 7) Design flow rate, pressure drop
- 8) Actual flow rate, pressure drop
- 9) Discharge pressure
- 10) Suction pressure
- 11) Total operating head pressure
- 12) Shut-off, discharge and suction pressures
- 13) Shut-off, total head pressure

L. Cooling Tower:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Model
- 5) Rated capacity
- 6) Entering air WB temperature, specified and actual
- 7) Leaving air WB temperature, specified and actual

- 8) Ambient air DB temperature
- 9) Condenser water entering temperature
- 10) Condenser water leaving temperature
- 11) Condenser water flow rate
- 12) Fan RPM
- 13) CFM, specified and calculated

M. Chiller:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Capacity
- 5) Model
- 6) Evaporator entering water temperature, design and actual
- 7) Evaporator leaving water temperature, design and actual
- 8) Evaporator pressure drop, design and actual
- 9) Evaporator water flow rate, design and actual
- 10) Condenser entering water temperature, design and actual
- 11) Condenser leaving water temperature, design and actual
- 12) Condenser pressure drop, design, and actual
- 13) Condenser water flow rate, design and actual

N. Air Cooled Condenser:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Model
- 5) Entering DB air temperature, design and actual
- 6) Leaving DB air temperature, design and actual
- 7) Number of compressors

O. Heat Exchanger:

- 1) Designation
- 2) Location
- 3) Service
- 4) Manufacturer
- 5) Model and type
- 6) Steam pressure, design and actual
- 7) Primary water entering temperature, design and actual
- 8) Primary water leaving temperature, design and actual
- 9) Primary water flow, design and actual
- 10) Primary water pressure drops, design, and actual
- 11) Secondary water entering temperature, design and actual
- 12) Secondary water leaving temperature, design and actual
- 13) Secondary water flow, design and actual
- 14) Secondary water pressure drops, design, and actual

P. Cooling Coil Data:

- 1) Designation

- 2) Location
- 3) Service
- 4) Manufacturer
- 5) Size, face area, and fins/inch
- 6) Airflow, design and actual
- 7) Entering air DB temperature, design and actual
- 8) Entering air WB temperature, design and actual
- 9) Leaving air DB temperature, design and actual
- 10) Leaving air WB temperature, design and actual
- 11) Water flow, design and actual
- 12) Water pressure drop, design and actual
- 13) Entering water temperature, design and actual
- 14) Leaving water temperature, design and actual
- 15) All pressure drops, design and actual

Q. Heating Coil Data:

- 1) Designation
- 2) Location
- 3) Service
- 4) Manufacturer
- 5) Size, face area, and fins/inch
- 6) Airflow, design and actual
- 7) Water flow, design and actual
- 8) Water pressure drop, design and actual
- 9) Entering water temperature, design and actual
- 10) Leaving water temperature, design and actual
- 11) Entering air temperature, design and actual
- 12) Leaving air temperature, design and actual
- 13) Air pressure drop, design and actual

R. Hydronic Flow Measuring Station:

- 1) Designation
- 2) Location
- 3) Manufacturer
- 4) Size
- 5) Model
- 6) Design flow rate
- 7) Design pressure drop
- 8) Actual/final pressure drop
- 9) Actual/final flow rate
- 10) Station calibrated setting

S. Sound Level Report:

- 1) Location
- 2) Octave bands--equipment off
- 3) Octave bands--equipment on

T. Vibration Test:

- 1) Location of points

- a) Fan bearing, drive end
 - b) Fan bearing, opposite end
 - c) Motor bearing, center (if applicable)
 - d) Motor bearing, drive end
 - e) Motor bearing, opposite end
 - f) Casing (bottom or top)
 - g) Casing (side)
 - h) Duct after flexible connection (discharge)
 - i) Duct after flexible connection (suction)
- 2) Test readings:
 - a) Horizontal, velocity and displacement
 - b) Vertical, velocity and displacement
 - c) Axial, velocity and displacement
 - 3) Normally acceptable readings, velocity and acceleration
 - 4) Unusual conditions at time of test
 - 5) Vibration source (if non-complying)

U. Duct Leak Test:

- 1) Description of ductwork under test
- 2) Duct design operating pressure
- 3) Duct design test static pressure
- 4) Duct capacity, airflow
- 5) Maximum allowable leakage equals duct capacity times leak factor
- 6) Test apparatus
 - a) Blower size
 - b) Orifice, tube size
 - c) Orifice size
 - d) Date of calibration
- 7) Test static pressure
- 8) Test orifice differential pressure
- 9) Measured leakage

V. Domestic Hot Water Recirculation Pump:

- 1) Pump flow rate.
- 2) Circuit setter flowrate.
- 3) Pump power.

W. Door Differential Pressure Test:

- 4) Test Apparatus
- 5) Description of doors tested (Pod #, Door #)
- 6) Preliminary door pressure differential.
- 7) Final door pressure differential.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 GENERAL

This section includes thermal insulation specifications for all plumbing and HVAC equipment.

- A. All insulation must meet or exceed State of Michigan 2015 Commercial Uniform Energy Code and standards specified by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers, ASHRAE 90.1-2013.

1.1 QUALITY ASSURANCE

- A. Bidders shall specialize in mechanical insulation application and have a minimum of three years' experience, or pre-approval for bidding from the engineer.
- B. Furnish insulation, jackets, coverings, sealers, mastics, and adhesives with flame-spread index of 25 or less, and smoke-developed index of 50 or less, in accordance with the Michigan Mechanical Code (MMC), ASTM E-84, NFPA 255, or UL 723.
- C. Insulation shall be furnished and installed in compliance with the National Commercial & Industrial Insulation Standards, Refer to www.insulation.org/index for manual information.

1.2 PERFORMANCE SPECIFICATION

- A. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of applicable building codes when tested in composite form per one of the following nominally equivalent test methods:
 - 1. American Society for Testing of Materials ASTM E-84
 - 2. Underwriters' Laboratories, Inc. UL 723 (CAN/ULC-S102-M88)
 - 3. National Fire Protection Association NFPA 255
- C. As specified in ASTM E-84, all insulation shall have a flame spread index not exceeding 25, and a smoke-developed index not exceeding 50.

1.3 SUBMITTALS

- A. Provide manufacturer data and installation sheets for each type of insulation material used.
- B. See General Requirements and/or Mechanical General Requirements for required format.
- C. Shop drawing submittals shall include:
 - 1. Job Name
 - 2. Supplier and contractor name, address, phone, and fax.
 - 3. Material specifications and intended area of use.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Owens Corning
- B. Certainteed
- C. Knauf
- D. 3M
- E. Insulation Solutions
- F. TVM Building Products
- G. Pabco-Childers Metals
- H. Armacell Engineered Foams (formerly Armstrong Insulation Company)
- I. TruBro
- J. McGuire Manufacturing Company

PART 3 MATERIALS

3.1 TYPE 1 - NON-FLEXIBLE, JACKETED, FIBERGLASS PIPE INSULATION

- A. Fiberglass pipe insulation
- B. Heavy density resin bonded inorganic fibers
- C. Formaldehyde Free
- D. Hinged sections to slip over pipe
- E. Smooth, reinforced, vapor retardant, all service jacket (ASJ)
- F. Longitudinal, pressure sensitive adhesive self-sealing lap seal and butt seal
- G. Approved for use up to 850 deg. F
- H. Meets ASTM C 547 (mineral fiber insulation), ASTM 1136 (vapor barrier), ASTM C 795 (austenitic stainless steel)
- I. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A

3.2 TYPE 2 - NON-FLEXIBLE, PVC JACKETED, FIBERGLASS PIPE INSULATION

- A. Same as Type 1, except shall be securely covered with 15 mil PVC jacket.
- B. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A

3.3 TYPE 3 - FOIL-BACKED, ALL SERVICE DUCT WRAP INSULATION

- A. 0.75 pounds per cubic feet (pcf)
- B. Thermal resistance, $R = 6.0 \text{ hr-sf-F/Btu}$ (2" thick)
- C. Foil, reinforced, kraft low permeance vapor retarder backing (foil-backed)
- D. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A
- E. Paper-backed insulation typically does not meet ASTM E-84, and shall not be approved.

3.4 TYPE 4 - PREFORMED PIPE AND P-TRAP COVERS FOR ADA BARRIER FREE LAVATORIES AND SINKS

- A. Soft molded vinyl exterior
- B. 1/8" thick with internal ribs
- C. Shall fit 1-1/4" or 1-1/2" cast brass, tubular P-trap assemblies, and schedule 40 PVC P-traps
- D. Bacteria and fungi resistance
- E. White color, latex paintable
- F. Cleanable
- G. ASTM D-635
- H. For specified use only

3.5 TYPE 5 - FLEXIBLE, CLOSED-CELL, PIPE INSULATION

- A. Closed-cell, flexible, elastomeric, piping insulation; or Foam Glass Brand insulation with Pit Wrap (Foam Glass insulation includes water resistance vapor barrier, and does not require a separate vapor barrier).
- B. Thermal Conductivity, $K = 0.27 \text{ Btu-in/hr-sf-F}$
- C. Vapor transmission 0.08 perm-in
- D. Non CFC, HFC, HCFC, manufactured, and formaldehyde free
- E. Mold and mildew resistant

- F. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A
- G. Include seam and butt joint adhesive
- D. Vapor transmission 0.08 perm-in
- E. Non CFC, HFC, HCFC, manufactured, and formaldehyde free
- F. Mold and mildew resistant
- G. Meets 25/50 flame and smoke developed index, ASTM E-84, NFPA 90A
- H. Include seam and butt joint adhesive
- I. Field fabricated insulated sheet metal cover to cover chilled-water pump casing and flanges
- J. Removable and reusable sheet metal cover

3.9 TYPE 9 – BURIED SUPPLY DUCT & RADIANT FLOOR AND SNOWMELT INSULATION

- A. High Density Polystyrene Insulation with Vapor Barrier
 1. High density extruded polystyrene sheets
 2. Thickness = 4”
 3. Thermal resistance, R = 20.0 hr-sf-F/Btu
 4. Compressive strength to meet use
 - a. UNDER SIDEWALKS AND OFFICE FLOORS: 25 psi (3600 lbf/sf), typical for radiant floor heat, sidewalks, and residential garages.
 - b. 40 psi (5760 lbf/sf), for light commercial garages, garage aprons, and driveways.
 - c. 60 psi (8640 lbf/sf), for medium duty commercial garages, garage aprons, and driveways.
 - d. IN TRUCK BAY AND UNDER APRONS TO BE SNOWMELTED 100 psi (14,400 lbf/sf), for heavy equipment garages, garage aprons, and driveways.
 - e. Refer to structural engineering and architectural drawings and specifications for further information, and verify use with general contractor.
 5. Install separate 4 mil polyethylene roll sheet underneath high density sheets for vapor barrier, permeance less than 0.08 perms
 6. ASTM D1621, ASTM E 96
 7. Not approved for other mechanical thermal insulation uses.

3.10 ACCESSORIES

- A. All insulation accessories shall meet state and local fire codes, and shall meet NFPA 90A for use within air plenums.
- B. Closure Materials including butt strips, bands, wires, staples, mastics, adhesives, caulks or sealants, pressure-sensitive tapes
- C. Support materials including hanger straps, hanger rods, saddles, and support rings, wire mesh, plastic ties, etc.
- D. Fastener materials including welded pin or adhesive pin mechanical fasteners, speed clips,

pressure-sensitive tapes, caulks or sealants.

E. Jackets and Prefabricated Fitting Covers

1. PVC Jackets

- a. Minimum 0.028 inch thick
- b. Bacterial and mildew resistant
- c. Designed for exterior use

2. Aluminum Jackets

- a. Aluminum Alloy
- b. 0.010" thick
- c. Moisture barrier
- d. Smooth finish
- e. Include 45 or 90 degree short and long radius elbows, and end caps as necessary

PART 4 INSTALLATION

4.1 INSULATION TYPE AND REQUIRED THICKNESS

Refer to the following Insulation Schedule areas of insulation use and insulation thickness. If a separate Plumbing Insulation Specifications is included do not apply this section for domestic CW, HW, and sanitary piping insulation requirements. Note: all PVC piping in plenums must meet insulated with jacket complying with ASTM E 84, UL-723.

<u>TYPE OF PIPING</u>	<u>TYPE</u>	<u>THICKNESS</u>
Domestic Cold Water Pipe, CW All Sizes	1	1/2"
Domestic Hot Water Pipe, HW All Sizes	1	1"
Underground CW or HW All sizes	5	3/4"
P-Traps and HW/CW Barrier Free Lavatories and Sinks (All Sizes)	4	1/8"
Heating Hot Water Pipe, HWS and HWR (All Sizes)	1	3/4"
Condensate Piping (All Sizes)	1	1/2"
Exposed Condensate Piping (All Sizes)	2	1/2"
Exposed Heating Hot Water Pipe, HWS and HWR (All Sizes)	2	1"
Underground Hot Water Supply and Return Pipe All Sizes	5	3/4"

4.2 GENERAL INSTRUCTIONS

- A. Install all materials in strict accordance to manufacturer's specifications.
- B. Install insulation after testing and testing approval is completed, in coordination with the mechanical contractor.
- C. Install insulation after heat tracing, or buried pipe tracing, is installed.
- D. Butt edges of insulation together, and seal joints with proper adhesives or jackets per

manufacturer specifications.

- E. Seal insulation butt joints with 3” pressure-sensitive tape.

4.3 TYPE 1, PIPE INSULATION

- A. Note: Not for underground use.
- B. Clean all piping free of dirt, grease, flux, etc.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
- D. Butt pipe insulation against hanger inserts. Secure with self-sealing facing tabs or 3” wide pressure sensitive tape.
- E. On non-serviceable unions, flanges, pipe terminations etc., provide prefabricated fitting covers.
- F. On serviceable items use removable and reusable, prefabricated fitting covers.

4.4 TYPE 2, PVC JACKETED PIPE INSULATION

- A. Only where piping is exposed outside of mechanical room. Note condensate piping requirements.
- B. Same as Type 1 insulation, with PVC jacket installed over pipe insulation.
- C. PVC jacketing shall be designed to fit over Type 1 insulation.
- D. Install PVC jacketing per manufacturer instructions.
- E. Install prefabricated PVC jacketing for:
 - 1. Elbows
 - 2. End-Caps
 - 3. Chilled water systems listed below
 - 4. Non-serviceable hot water piping systems listed below.
- F. Secure PVC jacketing with approved PVC sealant and banding.

4.5 PREFORMED PIPE AND P-TRAP COVERS FOR ADA BARRIER FREE LAVATORIES AND SINKS

ADA Barrier Free preformed pipe and P-trap covers shall be installed per manufacturer instructions where indicated on the Plumbing Drawings and Fixture Schedule.

4.6 TYPE 5, FLEXIBLE, CLOSED-CELL, PIPE INSULATION

- A. Insulate all underground CW & HW piping branch feed piping with minimum 3/4" Type 5 insulation.

- B. Clean all piping free of dirt, grease, flux, etc.
- B. Install insulation over all piping, unions, or flanges.

4.7 RADIANT TUBING AND SNOWMELT TUBING

- A. Insulate all underground radiant and snowmelt piping (buried branch piping) with minimum 3/4" Type 5 insulation that feeds manifolds and branch piping.
- B. Insulate under radiant floor tubing a minimum of 48" around perimeter of foundation wall, and vertical foundation wall using R-20 insulation. Insulate under all other radiant floor tubing using R-5 Type 9 insulation. See above for required insulation compression strength rating (psi). See Drawings for tubing and installation details.

END OF SECTION

SECTION 23 09 23
TEMPERATURE CONTROL EQUIPMENT

PART 1 – GENERAL –

1.1 SUMMARY

- A. See plans for equipment requirements and provide temperature control equipment as required below.
- B. System Architecture
 - 1. Provide stand-alone temperature controls complying with ASHRAE 90.1-2013 requirements.
- C. Operating Environment
 - 1. Ambient temperature: 32-110 degrees F.
 - 2. Relative humidity: 10-90% non condensing.
 - 3. Electrical supply: +/-10% of mains power.
- D. Sequence of Operations is included with this Section.

1.2 REFERENCES

- A. 13 53 16 Condensing Boilers

1.3 QUALITY ASSURANCE

- A. All materials used in this work shall be new, of the latest make/model currently in production and they shall be compatible with current server software version and of a type specifically manufactured for the use intended.
- B. Design Criteria
 - 1. The control system shall include all devices and wiring necessary to bring all building systems under control as specified herein and/or as shown on the Drawings.
 - 2. See Mechanical Drawings and Sequence of Operations.
- C. Uniformity and Supply
 - 1. Provide a system of consistent architecture and control philosophy, with similar components of uniform manufacture. Provide Control Units from a single manufacturer.
 - 2. Workstation hardware: May be sourced from a manufacturer other than the FMS supplier.
- D. Standards and Codes
 - 1. Only use system components that are UL listed, CE compliant for Electromagnetic Compatibility (EMC) and comply with FCC Part-15 as applicable.

1.4 MANUFACTURERS

Contact Engineer Aaron Wosek at Spicer Group (aaron.wosek@spicergroup.com) for approved equals or voluntary alternate. Must receive approval prior to bidding.

- A. Control Dampers:
 - 1. Ruskin
 - 2. Greenheck
 - 3. Contact Engineer for other Approved Equals or Voluntary Alternates.
- B. Control Damper Actuators
 - 1. Belimo.All others by Voluntary Alternate.

- C. Control Valve Actuators. For Control Valves (See 23 21 16 Hydronic Specialties).
 - 1. AHU Coils: Belimo, Model B, 3-way Characterized Control Valves (CCV)
 - 2. Chilled Water: Belimo 2-way CCV
 - 3. Steam: Belimo 2-way globe valve.
 All others by Voluntary Alternate:
- D. Control Valve Actuators:
 - 1. Belimo
 All others by Voluntary Alternate.
- E. Wall Thermostats
 - 1. Honeywell
 - 2. KMC
 - 3. All others by Voluntary Alternate Only

1.5 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of the Bid Date, and any subsections thereof as applicable, shall govern the design of equipment and materials supplied.
 - 1. UL 916 – Underwriters Laboratories Standard for Energy Management Equipment.
 - 2. NEC – National Electrical Code
 - 3. BACnet – ASHRAE Standard 135

1.6 SUBMITTALS

- A. General
 - 1. See 23 00 00 HVAC for Submittal requirements.
- B. Valve selection
 - 1. Submit valve selection details showing valve size, valve coefficient, design flow rate, valve pressure drop and respective coil pressure drop for each valve.
 - 2. Since flowrates, pressures, etc., may not be listed on existing mechanical plans contact Engineer, Aaron Wosek at Spicer Group (aaron.wosek@spicergroup.com) to coordinate valve selections.
- C. Damper Selection
 - 1. If applicable: Submittals must include leakage, maximum airflow and maximum pressure ratings based on AMCA Publication 500. Dampers shall meet the leakage requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and shall be AMCA licensed as Class 1A. Dampers shall be Ruskin model CD60.
- D. Manuals
 - 1. See 23 00 00 Mechanical General Conditions for manual requirements. Include the following:
 - a. Updated functional specification.
 - b. Specification sheets and technical brochures on all equipment.
 - c. Listings and description of application programs.
 - d. Programmer's manual.
 - e. Operator's manual including schedules of alarms, parameters, status, analog indicators, etc,
 - f. Circuit diagrams.
 - g. Drawings.

2. Final submission: Within one week prior to date of Substantial Completion, provide three (3) sets of manuals.
3. Final payment and project close-out shall not take place without the submission of manuals.

PART 2 – PRODUCTS

Only products required for this project apply.

2.1 CONTROL DAMPERS

- A. General: Furnish and install, at locations shown on plans, or in accordance with schedules, control dampers, complying with ASHRAE 90.1-2013, manufactured by an ISO 9001 accredited manufacturer that meet the following minimum construction requirements.
- B. Damper Frames: Damper frames (when size permits) shall be constructed of roll-formed structural hat channels, reinforced at the corners, formed from a single piece of minimum 16 gauge (1.6) galvanized steel. The roll-formed frames shall be structurally superior to 13 gage U-channel frames.
- C. Damper Blades Configurations:
 - Opposed Blade Dampers are required for all proportional airflow inlet or outlets or for standard 2-position operation.
 - Parallel Blade Dampers may be used for 2-position, open-closed, applications only.
- D. Damper blades shall be airfoil type for superior pressure drop performance and low noise generation. They shall be formed from a single piece of galvanized steel through a 20-stage roll-form process and shall be equivalent to other type blades constructed from 14 gauge (2.0) galvanized steel. Blade edge seals shall be flexible and suitable for -72°F (-60°C) to +275°F (+135°C) mechanically locked into the blade edge yet easily replaceable in the field.
- E. Jamb Seals: Jamb seals shall be flexible stainless steel, compression type to prevent leakage between the end of the blade and the damper frame. Use of the blade end to overlap the frame for a jamb seal is not acceptable. Adhesive or clip-on type seals for blade and jamb seals are not acceptable.
- F. Bearings shall be corrosion resistant, permanently lubricated stainless steel sleeve type turning in an extruded hole in the damper frame. Axles shall be ½” (13) plated steel, hexagon shaped and positively locked into the damper blades (round axles are not acceptable).
- G. Linkage: Linkage shall be concealed out of airstream, within the damper frame to reduce pressure drop, noise and maintenance.
- H. Manufacturers: Ruskin, Greenheck (See Schedules)

2.2 ACTUATORS

- A. Actuators
 1. All electronic actuators shall be sized according to the manufacturer’s recommendations for the applications described on the drawings and/or specifications.
 - a. Proportional
 - 1) High resolution electronic actuator
 - 2) Current limiting circuitry.
 - 3) Fail-safe, spring return

- 4) 2-10 VDC control signal or 3-point floating control.
- 5) 24 VAC control power.
- 6) Position feedback (tied into an analog input on the associated controller).
Two-position electronic
- b. 24 VAC control power.
2. Electro-thermal actuators are not acceptable.
3. Actuators shall be equipped with manual positioner (hand wheel or lever) to allow for manual positioning in the absence of control power.
4. Wiring to control valve actuators
 - a. Factory installed pigtails on valve actuators may be installed exposed (no conduit). Splices to the pigtail shall be within a splice box and all wiring from that point shall be within conduit.
 - b. If no factory installed pigtails are provided, field installed SO cord (plenum rated) may be used up to two feet in length from the terminals on the valve actuator to a splice box. Provide strain relief on each end of the SO cord.
5. Manufacturers: Belimo. All others by Voluntary Alternate.

2.3 INPUT DEVICES **(Not all shall apply to this project)**

- A. Room Temperature Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
 1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over 32 to 96 deg. F. range.
 2. Except where noted, all room sensors shall have an LCD display for viewing room temperature, room temperature set point and outside air temperature. All of these points, including set point adjustment, shall be able to be disabled through software.
 3. Must include programmable temperature adjustment range, and over-ride functionality.
 4. Where noted, use a blank tamperproof cover, with sensor and integral communications jack to communicate with the zones unitary controller.
 5. Install 5' above finished floor unless otherwise indicated.
- B. Duct Temperature Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
 1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over 32 to 158 deg. F. range.
 2. Locate in the main air stream as close to the center of flow as is possible.
- C. Immersion Temperature Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
 1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over 32 to 158 deg. F. range.
 2. Provide stainless steel or brass thermowell for threaded mounting into pipe.
 3. Thermal paste shall be used in all thermowells.
- D. Outside Air Temperature (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
 1. 10K ohm @ 77 deg. F. thermistor, +/- .36 deg. F. accuracy over -40 to 150 deg. F. range.

2. Install away from exhaust/relief vents. Preference should be given to locate as near as possible to the outside air intake for the air handling equipment which it shall help to control, but keeping it out of direct sunlight or other sources of influence which would adversely affect it's accuracy. When possible the sensor should be located on the northwest outside building wall.
 3. Outside air temperature sensors shall not be mounted within the intake air plenum or ductwork.
- E. Humidity Sensor (or Smart Sensor as defined by ANSI/ASHRAE Standard 135-1995, Addendum d)
1. 0% to 100% RH range, +/- 3% accuracy. Applies to duct or space sensors. Space sensors shall be incorporated in the same housing as the zone or room temperature sensor where available.
- F. Current Operated Switches (Fan and Pump status)
1. Kele & Assoc. PD75 series, Veris Ind. Hawkeye 705, or approved equal.
 2. Adjust to detect belt or coupling breakage under minimum flow conditions.
 3. An alternate device for a status input, which is tied to a digital output, may be an analog type current transformer if the system hardware/software accepts this type of proof.
- G. Air Pressure Differential Analog Sensor (Filter status).
1. Mamac Systems model PR-274-R3-VDC (see H.5 below)
- H. Static Pressure Transducers
1. Mamac Systems
 2. 24 VAC supply
 3. 0-5 VDC – Output
 4. Model PR-274-R2-VDC for building/room differential pressure control (-0.25" to +0.25" Wg)
 5. Model PR-274-R3-VDC for Duct static pressure (0" to 5" Wg, or as indicated on the Drawings).
- I. Air velocity
1. Atkinson Electronics PACM//02S Programmable Analog Control Module with SVP velocity probe, or approved equal.
- J. Carbon Dioxide (CO2) Sensors
1. Teleair, Honeywell, KMC, Trane, JCI
 2. 24 VAC supply
 3. 0-5 VDC – Output
 4. Model PR-274-R2-VDC for building/room differential pressure control (-0.25" to +0.25" WG)
 5. Model PR-274-R3-VDC for Duct static pressure (0" to 5" Wg, or as Indicated on the Drawings).

2.4 RELAYS

- A. 8-Pin, octal base, DPDT, with manual push-button operator and integral indicator light.
1. Exception: specialty relays such as time delay or interval timers which may be: 11-pin, SPDT, need not have manual operators or indicator lights.

- B. Matching socket snap-mounted on standard DIN-rail.

2.5 ENCLOSURES

A. General

1. All controllers, power supplies and relays shall be mounted in enclosures.
2. Enclosures may be NEMA 1 when located in a clean dry indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean dry environment.
3. Enclosures shall have hinged, latching doors.

B. **Not applicable to this project:** Enclosures for Supervisory or General Purpose Controllers in Mechanical Spaces:

1. A gutter (minimum 6"x6"x6") shall be furnished and installed directly beneath or above each controls enclosure by the Controls Contractor. All home runs (control, signal and communication) shall enter this gutter. Wiring shall then be routed from the gutter through minimum 1" conduits to each of the controls enclosures. All circuits in the gutter and controls enclosure shall be Class II or III (as defined by NEC).
 - a. Power Supplies, transformers or other devices requiring 110 VAC (or greater) power shall be mounted in a separate enclosure. A sign warning of the presence of High Voltage inside shall be placed on the door.
2. Analog input cables shall be in separate raceways from all other control wiring from the gutter mounted beneath Controls enclosure to the input device. Exception: power supply wiring for powering field mounted analog input transducers.
3. See Part 4 Details for installation diagram.

C. **Not applicable to this project:** Controls enclosures for Terminal Units:

1. Enclosures shall be NEMA 1 and shall be integral to the controller where possible. Terminal unit controllers without integral enclosures may be mounted directly to 4-square boxes where designed to do so, but in no case shall controllers be mounted directly to the terminal unit or lack the provision for concealed connection of all wiring terminations.
2. ½" Flex (minimum) from the power supply mounted within 2 feet of the terminal unit and ½" flex (minimum) from the I/O & Communications 4-square box mounted within 2 feet of the terminal unit shall terminate at this enclosure.
3. No open wires shall be allowed at the terminal unit.
 - a. Exception: Pigtail cabling to damper operators and/or valve actuators.

2.6 MONITOR AND CONTROL POINTS (apply to the required stand-alone programmable thermostats)

- A. Provide all analog, binary, and digital sensors and control devices as specified and required for a complete and working temperature control system. The installation of such devices and sensors shall be the responsibility of the Contractor. Contractor shall also provide all required auxiliary contacts, relays, transformers, transducers, resistors, etc. to perform the monitoring of control functions specified. Sensors and their connections shall be electronic or electric.
- B. Where, due to the size of the damper or coil, multiple damper operators or control valves are specified, the control for this combination of actuators and valve operators shall be specified as

one control point. The contractor shall provide all wiring, tubing, and relays to operate these control devices as one unit.

C. Not all control points listed below shall specifically apply to this project. Field verify the requirement for each.

D. Control Point Type

Reference only for this project: General: The Contractor shall provide the current industry standard equivalent control point to those listed below and that which interfaces and integrates with the new Temperature Control System.

1. Temperature (Analog Input)
 - a. Space Temperature: Sensor installed in wall-mounted tamperproof enclosure with locking covers. Since aesthetics are of the highest concern with all visible elements, sensor enclosure must be kept as unobtrusive as possible. All enclosures are subject to approval of the Architect, submit samples.
 - b. Return Air Temperature: Upstream of outside air connection.
 - c. Mixed Air Temperature: Provide averaging type sensor.
 - d. Coil Discharge: Downstream of coil in unit casing. Where coils are installed within same unit casing and distance between coils is minimal, use averaging type sensors mounted off coil face.
 - e. Outside Temperature: Provide rainproof enclosure and solar shielding. Sensor to be located on roof or on side of bulkhead. Submit locations for approval by A/E.
2. Relative Humidity (Analog Input)
 - a. Outside Relative Humidity: Provide rainproof enclosure and solar shielding. Sensor to be located on roof or on side of bulkhead. Submit location for approval by A/E.
 - b. Space Relative Humidity: Sensor installed in wall-mounted tamper proof enclosure. Since aesthetics are of the highest concern with all visible elements, sensor enclosures must be kept as unobtrusive as possible. All enclosures are subject to approval of the Architects, submit samples.
3. Fan Status (Analog Input)
 - a. Provide current transducer (CT) for each fan to indicate Fan motor load. Calibrate CT with software to indicate normal operation, broken belt, and overload.
 - b. CT shall also be used to sense “single phasing” power failure and automatically shutdown affected fan.
 - c. (Digital Point) Where indicated provide differential pressure switch across the fan.
4. Exhaust Fans Status (Digital Input)
 - a. Duct or Plenum Mounted Fans: Provide differential pressure switch across fans.
 - b. Mushroom Type Fan: Provide sail switch in ductwork upstream of fan.
 - c. Provide auxiliary contacts and relays to monitor fan starter status to determine if fan is required to be on.
5. Pump Status (Digital Input)
 - a. Provide differential pressure switch across pump to prove flow.
6. Filter Alarm (Analog Input)
 - a. Provide differential pressure sensor with sensing element across each filter in the filter bank. Indication shall be by means of software as differential pressure rises above a preset adjustable setpoint. Utilize variable capacitance sensor with 4-20 MA transmitter. Accuracy including non-linearity hysteresis and non-repeatability is within 1% of full scale.
7. Contact Closure (Digital Input)
 - a. Provide control relays and auxiliary contacts to monitor the following:
 - b. Equipment status or summary alarm.

- c. Operating mode and ready.
 - d. Freezestat.
 - e. Damper end switch. For each air handling system, damper end switches shall be annunciated at a local panel. A summary alarm for each shall be annunciated at the BAS.
 - f. Smoke damper end switches. End switches for these dampers must be annunciated individually.
 - g. Single phase alarm. Contact closure from motor control center to indicate loss of phase leg. Upon sensing alarm, BAS shall shut down all equipment associated with that motor control center.
8. Pressure Sensor (Analog Input)
 - a. Provide pressure sensor in piping.
 9. Carbon Dioxide Sensor (Analog Point)
 - a. Provide carbon dioxide sensors located adjacent to space thermostat.
- E. Control Points
1. Start/Stop or Enable Disable (Digital Output Point)
 - a. Start/Stop relay module shall contain two (2) single pole, double-throw relays for start/stop functions at the remote point, with both relays mounted on a circuit board and factory wired to numbered terminal strips.
 - b. Where multiple relays are required for a single start/stop point, Contractor shall furnish and install all relays and necessary controls interface.
 - c. Where an Enable/Disable point is called for, connect to equipment controls to maintain all normal start up and shut down sequences, interlocks, and safeties.
 2. Damper Control-Modulating (Analog Output)
 - a. DCP shall be in direct digital control of damper positions to affect the specified sequences of operation.
 - b. Dampers on units with CO2 sensors in the return air shall be of the modulating type.
 3. Damper Control - 2 Position (Digital Output)
 - a. DCP shall be in direct digital control of minimum outside return air or make up air dampers.
 4. Control Valve - Modulating (Analog Output)
 - a. DCP shall be in direct digital control of heating and cooling, control valves to affect the specified sequence of operation.
 5. Control Valve - 2 Position (Digital Output)
 - a. DCP shall be in direct digital control of valve position.
 6. Control Mode Selector (Digital Output)
 - a. DCP shall be in direct digital control of selector switch to index equipment to various modes of operation. See Sequence of Operation.
 7. Reset Signal (Analog Output)
 - a. DCP shall send output signal to reset port of equipment control panel.
 - b. Reset shall include chilled water temperature.
 - c. BAS contractor shall coordinate with equipment manufacturer as to the proper reset signal (4-20 ma, 0-10 vdc, etc.).
 8. Carbon Dioxide Sensors (Demand Control CO2 Ventilation)
 - a. Carbon dioxide sensing cell shall consist of a nondispersive infrared carbon dioxide gas cell that uses a pulsed source and has no free air optical path. Output shall be linearized 4-20 Ma with the 24 VDC input. In addition, the unit shall be capable of providing SPDT switching of an external low voltage circuit at an adjustable setpoint. The unit shall be specifically designed for the wall or duct application specified. Return air aspiration boxes shall be designed by and approved by the manufacturer.

Unit shall have single point setpoint and span adjustment. The unit shall have no moving parts.

- b. Power for the sensor shall be extended from a transformer or adaptor installed adjacent to the DDC control panel, and shall be run parallel to the 4-20 Ma signal cable.
- c. Minimum requirements:
 - 1) Range 0-2,000 ppm
 - 2) Accuracy 3% full scale
 - 3) Repeatability 1% of full scale
 - 4) Power Consumption < 3 watts
 - 5) Relay contact rating 1 amp @ 28 VDC
 - 6) Drift Zero Drift at 100 ppm per 24 hours (random, not cumulative).
 - 7) Maximum allowable drift in 1 yr 100ppm
- d. Contractor shall provide all necessary equipment and test gas for calibration and shall calibrate all CO2 sensors in accordance with the manufacturers' recommendations.

7 WALL CONTROLLER THERMOSTATS AND SENSORS

A. Adjustable Thermostats

- 1. Where shown on plans provide digital programmable stand-alone thermostat.
 - a. The thermostat shall include backlit LCD display and temperature display.
 - b. Wall controller/thermostats shall include Auto-change-over heating and cooling and Manual Change-over heating and cooling selection. The Owner shall determine if Auto-change-over or manual change over is most effective.
 - c. Adjustable temperature (provide +/- 5.0 degree F adjustment range from normal setpoint).
 - d. **Not applicable to this project**: Provide heavy duty, polycarbonate, tamper-proof, keyed thermostat covers where noted on plans.

B. **Not applicable to this project**: Sensors (if applicable per drawings)

- 1. Where shown on plans provide temperature sensors only.

2.8 ASSOCIATED EQUIPMENT

A. **Does not apply to this project**: Electric Thermostats: Electric thermostats where specifically noted, 2-position line voltage heavy-duty snap-acting type.

B. Local and Auxiliary Control Panels

- 1. Unitized cabinet type for each system under automatic control with relays and 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.
- 2. ANSI/NEMA 250, general-purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
- 3. Panels shall be sized for a maximum fill of 60% capacity.

C. Duct Pressure Probes

- 1. Duct static pressure probe shall be capable of static pressure measurement with bi-

- directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.
2. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.
 3. The duct pressure transmitter will be located near end of supply duct main common to an area requiring the most to satisfy air delivery.
- E. Electric low limit freeze protection thermostats shall be provided for all systems with water coils (whether or not described in sequence of operation) and have 20 ft. low point sensitive elements (not averaging type), installed to cover the entire cooling coil face area. The elements shall be suspended one-inch upstream of the cooling coils. These thermostats shall be two-position manual reset type. Where coils are 2 banks wide, multiple freeze protection thermostats wired in series shall be provided. Any one thermostat shall stop the supply fan and if specified, sound an alarm at the BMCS on a drop in temperature below its setting.
- F. Pump proof-of-flow switches shall be adjustable differential pressure or type rated at 150 psi except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 300 psi body. Differential pressure switches shall have valved manifold for servicing.
- G. System water differential pressure sensor equal to DPT2300, 0-25 PSI (TCC to verify), 0-10 vdc.
- H. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

PART 3 - EXECUTION

3.1 ELECTRICAL WIRING

- A. Provide all control wiring under this Section regardless of voltage. All control wiring shall be installed under the direct control and supervision of the Control Contractor. Provide wiring for all control devices specified herein, shown on drawings, or supplied with specified mechanical equipment.
- B. Provide interlock wiring.
- C. Provide all other wiring required for the complete cooperation of the specified systems including required transformers.
- D. Run control wiring in conduit where exposed lower than 8' above floor. Conduit shall comply with the requirements of the Electrical Specification.

3.2 WIRE AND CABLE

- A. Wire and cable connection for the system shall be as follows:

1. All wiring shall be selected and installed per controller manufacturer installation instructions or per industry standards.
 2. Provide plenum rated cabling that runs through return air plenums. Field verify locations.
- B. Wiring shall be in accordance with the requirements of Division 26, 27, & 28.
1. All wire, cables and control transformers shall be furnished and installed by the Controls Contractor. Includes interlock wiring required to provide a complete, operational control system. Exception: Power wiring for smoke dampers furnished under this Section shall be as specified in Section 16721.
 2. All analog input wiring shall be twisted pair cabling.
 - b. Exception: Field mounted transducers that require separate power supply may use multi-conductor cabling.
 3. All other I/O and power supply wiring shall be 18 AWG (minimum) TFFN, unless specifically required by the system manufacturer and approved by the Engineer for each specific installation.
 4. All signal and low voltage control wiring shall be stranded wire. No solid core wire. All low voltage wire and control wire shall be installed in raceways unless noted otherwise.
 5. All control wiring shall be labeled at each end, including spares.
 - a. Labeling shall be identified on As-built drawings.
 - b. Labels shall be self-laminating vinyl film or approved equal.
 - c. No hand written labels. Labeler printed only.
 6. Allow for a minimum of 12” of slack in all wiring as it passes through the gutter mounted beneath the controls enclosures in the mechanical spaces.
 7. Splices shall not be allowed.
 8. All digital input, analog input, analog output and pulse-counter signals shall be isolated from earth ground (floating).
 9. Where raceway is attached to equipment, provide ample flexible conduit to permit normal machinery movement.
 10. “Across-the-hinge” wiring shall be dressed to avoid strain and abrasion. Provide spiral wrap suitable to this application.
- C. Temperature Control System Network Communications Wiring:
1. Wire shall be of type as specified by Control System Manufacturer. If manufacturer has no requirement, then minimum quality of communication wire installed shall be equal to 24 gage Cat 6 shielded, plenum-rated (if installed in return air plenums – see plans for RA plenum locations).
 2. Wiring shall be in a separate raceway from all other wiring (except as noted elsewhere) from the gutter mounted above or below the controls enclosure in the mechanical space to the tie point.
 - a. Allow 12” of slack in the gutter.
 - b. There shall be no splices in Communications wiring.
 - c. Coordinate installation of the data/voice jack (in close proximity to the Supervisory Controller or General Purpose Standalone Controller) in each mechanical space.
- D. Terminal Unit Wiring.
1. Supply power:
 - a. 110 VAC power shall be run to each transformer location. Coordinate with Division 16 Contractor.
 - b. 110 VAC x 24 VAC transformers (100 VA maximum, 40 VA minimum), supplied and installed by Controls Contractor shall be located within 2 feet of the terminal unit.
 - c. 24 VAC shall be Class II circuit.

- d. 24 VAC supply power shall be fused at 4 amps maximum. Fuse shall be accessible without having to remove any covers.
 - e. Flex conduit is to be used between the transformer and the terminal unit controller enclosure.
2. Other wiring:
- a. Sub-Network Communication and room sensor/auxiliary I/O wiring shall be run in separate conduits to a single 4" square J-Box (separate from supply power) mounted to the structure within 2 feet of the terminal unit. Flex conduit is to be used between this J-box on the structure and the terminal unit controller enclosure. Sub-Network Communication, room sensor and auxiliary I/O wiring may be combined in the flex to the terminal unit controller enclosure.
 - b. Communications wiring may also be combined with other I/O wiring in the gutter mounted beneath the controls enclosure in the mechanical space only. All other communications wiring shall be in a separate raceway.

3.3 INSTALLATION

- A. Install the system as recommended by the manufacturer, using only equipment recommended or acceptable to the manufacturer.
- B. Comply with the State and Local Electrical Code for electrical work. Run all wiring in exposed areas in conduit. Run all wiring in finished spaces concealed. All equipment located outside shall be in suitable weather tight enclosure.
- C. Install all conduit, wiring, and cable, and install all equipment in first-class manner, using proper tools, equipment, hangers, and supports, and in locations as required for a neat, attractive installation. No material shall be exposed if it is possible to conceal it. Exposed materials shall be installed only with consent of the engineer.
- D. Raceways to all control devices shall conform to the requirements of 2014 NEC.
 - 1. Layout of raceways shall be as shown on the Contract Drawings and/or specified herein.
 - 2. Layout of communications raceways shall be installed per the manufacturers' recommendations.
 - 3. Layout for I/O raceways on air handling units generally require three 4" sq. boxes for analog inputs (one at each end of the AHU and one at the mixed air plenum), and three 4" sq. boxes for all other I/O (one at each end of the AHU and one at the mixed air plenum). Provide additional boxes and raceway so that final wire fill does not exceed 60% of total available capacity. All wiring in mechanical rooms to be in raceway with sufficient j-boxes, flex, etc. to allow for connection to all devices without exposed wiring.
 - 4. Minimum conduit size to be ¾".
 - 5. It shall be the responsibility of the Controls Contractor to review the Contract Documents to confirm that the designated layout is correct for their hardware and conduit sizing (¾" minimum) is sufficient to all devices.
 - 6. Any required changes shall be noted in a timely manor to allow for any changes prior to rough-in of other conduit in order to make for a complete and orderly installation with minimized cross-overs or other conflicts.
- E. Support all sensors as recommended by the manufacturer where inside equipment such as ductwork. Sensors in the space shall be in small, attractive housings designed for that purpose and mounted on an electrical junction box.
- F. Control Damper Installation:
 - 1. Install dampers at locations indicated on the drawings and in accordance with

- manufacturer's installation instructions.
2. Install dampers square and free from racking with blades running horizontally or vertically as required.
 3. Do not compress or stretch damper frame into duct or opening.
 4. Handle damper using [sleeve or] frame. Do not lift damper using blades or jackshaft.
 5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.4 FIELD TESTS AND ACCEPTANCE

- A. The Contractor shall provide the services of both a control system technician and a fully qualified building automation control technician who, in the presence of a representative of the Owner and A/E will perform the tests. Tests will be witnessed after the Contractor is satisfied that the system has been adjusted and is operating in accordance with the Specification requirements.
- B. Test Procedure
 1. Temperature, Pressure, and Humidity Indication: Field measure values with test instruments; local instrument (if any) and remote display at console.
 2. Analog Limit Alarms: At the console, raise the low limit to a point above the actual measured reading in the field. Alarm should report in and be logged in on the printer. For high limit, lower the setpoint.
 3. Setpoint Reset: In field, measure condition of controlled medium with test instrument. Read corresponding value at console and read branch signal output with test instrument. Branch signal should be in same proportion of its full range as the measured medium reading is to the throttling range of the controller. Resetting the control point at the console should result in a proportionate change in branch signal.
 4. Contact Indication and Alarms
 - a. For subsystems, simulate actual function or operation in field. Jump contacts where simulation is not practical.
 - b. High or Low Limit Temperature Sensors: Simulate required limit temperature by immersing sensor in liquid of proper temperature (or other practical means). Alarm should report in at console. Repeat tests with high limit setting reduced and low limit setting increased by 5 degrees F; alarm should not report in at console.
 - c. Pressure Differential at Filters: Impress artificial pressure on high-pressure connection to simulate design differential pressure limit condition. When limiting differential pressure is reached, alarm should report in at console.
 - d. Mode Change: Change mode setting at console and observe change of controlled element in field.
 - e. Proving Devices: Operate related systems to activate devices and compare specified resultant function or operation.

3.5 MAINTENANCE SERVICE

- A. The Contractor shall perform complete maintenance of the Temperature Control Contractor for a period of one calendar year, at no additional cost to the Owner, commencing with the date when the system is accepted so that the said controls may be operated 24 hours a day, 7 days a week.
- B. The maintenance service for one year shall include all the existing actuators and control valves, compressors, air dryers and pressure regulators which are to remain and which have been either maintained and repaired or replaced as required.
- C. The Contractor shall be on-site within four (4) business hours of the service request, and shall

repair, replace and re-program as soon as possible, any part or parts of the controls and system, which become unsuitable for continued use. The service performed by the Contractor shall include but not be limited to the following:

1. Every 90 days within the 1-year warranty period, systematically examine, adjust, calibrate and clean all sensor, temperature controls, pressure controls, valves, relays, motors and accessories.
 - a. Systematically, furnish lubricants and lubricate such components as valve packing glands, damper bearings, linkages and switches pertaining to the control package.
 - b. Replace valve-packing materials of control valves as often as may be necessary in order to maintain the valves without leakage.
 - c. Update all software and correct all "bugs". Modify presentation graphics based on Owner's operating experience.
- D. The Contractor shall submit to the Owner a detailed record of all maintenance and servicing performed under this Contract and shall notify the Owner if during the performance of services, additional repairs or replacements have to be scheduled.

3.6 OPERATOR TRAINING

- A. See Section 23 09 01 Digital Temperature Control System for training requirements.

3.7 SEQUENCE OF OPERATIONS:

- A. Furnaces: Each furnace system shall be controlled by a 7-day programmable T-stat. The furnace shall be manually entered into heating or cooling mode. During occupied periods the supply air fan shall operate continuously. In heating mode the furnace burner shall stage to maintain space temperature to +/- 1.0F. In cooling mode the furnace controller shall relay the condensing unit to stage to maintain the space temperature to +/- 1.0 F.
- B. Boiler: See Boiler and Radiant Floor Operation and Sequence of Operations Notes on plans. The boiler shall operate by use of the factory controller. P-B1 shall energize and the boiler shall automatically energize and modulate the burner when the outdoor air temperature falls below 50F (adj.). The HWS temperature shall be controlled by an outdoor reset controller. The maximum HWS temperature shall be 140F. On a call for domestic hot water the boiler shall enter domestic priority mode, and ramp up HWS temperature to 180F until the indirect water heater tank temperature is satisfied.
- C. Manifold pumps, P-1 and P-2 shall operate to maintain the Truck Bay space temperature to +/- 1.0F.
- D. P-3 (the office radiant floor pump) shall operate continuously with P-B1 when the outdoor air temperature falls below 50F.
- E. Gas unit heater, UH-1, shall be controlled by a programmable thermostat. The unit heater shall provide heat for make-up air and supplemental heat. The unit heater T-stat should be set a 5.0 degrees F (adj.) below the radiant floor thermostat that serves P-1 & P-2. When the overhead doors or louver, L-1 control damper open, the unit heater shall energize and stage heater to offset cold air infiltration into Truck Bay. Failure to fix UH-1 setpoint below the P-1 and P-2 setpoint will prevent normal operation of the radiant heat.
- F. Gas Monitor Controller: The gas monitor system shall energize EF-1 and open the control damper on L-2 when space CO levels exceed 3.0ppm or NO2 levels exceed 25.0ppm. Set up Gas Monitor Controller in strict accordance to manufacturer installation instructions.
- G. EF-2 must operate continuously 365 days per year per 2015 MMC.
- H. Mini-split, MS-1/HP-1 shall operate by use of a factory wall mount, programmable thermostat. The unit shall maintain heating or cooling setpoint to +/- 1.0F.
- I. The Tekmar Snowmelt Controller shall relay P-SM-1 on a call for snowmelt. Install and program

per Tekmar installation instructions.

SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and pipe fittings for:
 - 1. Heating water piping system.
- B. In-slab piping for heating and snowmelt
 - 1. PEX(A) tubing, manifolds, and fittings.
- C. Valves:
 - 1. Globe or angle valves.
 - 2. Ball valves.
 - 3. Butterfly valves.
 - 4. Check valves.

1.2 REFERENCE STANDARDS

- A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2004.
- B. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005) (ANSI B16.18).
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).
- E. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2004 (ANSI/ASME B31.9).
- F. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2006a.
- G. ASTM A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2006a.
- H. ASTM B 32 - Standard Specification for Solder Metal; 2004.
- I. ASTM B 88 - Standard Specification for Seamless Copper Water Tube; 2003.
- J. ASTM F 876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2007.
- K. ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems

- L. ASTM F 2389-07 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
- M. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications
- N. NSF/ANSI 14 – Plastic Piping System Components and Related Materials
- O. Uponor Snow and Ice Melting Design Manual, 3rd edition & Radiant Floor Installation Handbook, 6th edition.

1.3 SYSTEM DESCRIPTION

- A. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- B. Use globe valves for throttling, bypass, or manual flow control services.
- C. Use 3/4 inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
- D. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems only. Closed systems do not require dielectric unions.
- E. Snowmelt and Radiant Systems:
 1. Performance Requirements: Provide hydronic snow and ice melting system that is manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the PEX tubing manufacturer without defects, damage or failure.
 2. Show compliance with ASTM F877.
 3. Show compliance with DIN 4726 regarding oxygen diffusion concerns where applicable
 4. Show compliance with ASTM E119 and ANSI/UL 263 through certification listings with Underwriters Laboratories, Inc. (UL).
 - a. UL Design No. L557 — 1 hour wood frame floor/ceiling assemblies
 - b. UL Design No. K913 — 2 hour concrete floor/ceiling assemblies
 - c. UL Design No. U372 — 1 hour wood stud/gypsum wallboard wall assemblies
 - d. UL Design No. V444 — 1 hour steel stud/gypsum wallboard wall assemblies

1.4 SUBMITTALS

- A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- B. Welders Certificate: Include welder's certification of compliance with ASME (BPV IX).
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Project Record Documents: Record actual locations of valves.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Engineer.
 - b. Use rigid joints unless otherwise indicated.
 - 4. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
- D. Valves: Provide valves where specified and indicated on the floor plans and the details.

2.2 **Not Applicable to this project:** LOW PRESSURE STEAM PIPING (15 PSIG MAXIMUM)

- A. Steel Pipe: ASTM A 53, Schedule 40, black.
 - 1. Fittings: ASME B16.3 malleable iron Class 125, or ASTM A 234/A 234M forged steel Class 125.
 - 2. Joints: Threaded, or AWS D1.1, welded.
- B. Steel Pipe Sizes 12 Inch and Over: ASTM A 53, 0.375 inch wall, black.
 - 1. Fittings: ASTM A 234/A 234M forged steel Class 125.
 - 2. Joints: AWS D1.1, welded.

2.3 **Not Applicable to this project:** LOW PRESSURE STEAM CONDENSATE PIPING

- A. Steel Pipe: ASTM A 53, Schedule 80, black.

1. Fittings: ASME B16.3 malleable iron Class 125, or ASTM A 234/A 234M forged steel Class 125.
 2. Joints: Threaded, or AWS D1.1, welded.
- B. Steel Pipe Sizes 12 Inch and Over: ASTM A 53, 0.375 inch wall, black.
1. Fittings: ASTM A 234/A 234M forged steel Class 125.
 2. Joints: AWS D1.1, welded.

2.4 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A 234/A 234M, wrought steel welding type fittings; AWS D1.1 welded.
 2. Threaded Joints: ASTM B 16.3, malleable iron fittings.
 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
 4. Fittings: ASTM B 16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type fittings.
 5. Joints: Threaded, or AWS D1.1 welded.
 6. In addition to the 1-year standard warranty, Contractor shall provide an extended 3-year labor and material warranty (two (2) additional years) on all piping and valve installations.
- B. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn, using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B 32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8/A5.8M BCuP copper/silver alloy.
 2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
 3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 4. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver.
 5. In addition to the standard 1-year warranty, the Contractor shall provide an extended 3-year labor and material warranty (two (2) additional years) on all piping and valve installations.
- C. Polypropylene Piping **(Voluntary Alternate Only)**
1. Pipe shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the hydronic hot water and heating piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.
 2. Pipe shall be Aquatherm® Green Pipe® MF®, Blue Pipe® MF®, or Blue Pipe® MF® RCT® available from Aquatherm, NA. Piping specifications and ordering information are available at www.aquatherm.com.

3. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.
4. Fittings shall be Aquatherm® Green Pipe® MF®, Blue Pipe® MF®, or Blue Pipe® MF® RCT® available from Aquatherm, NA. Fittings specifications and ordering information are available at www.aquatherm.com.
5. Manufacturer shall warrant pipe and fittings for 10 years to be free of defects in materials or manufacturing. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing. Warranty shall be in effect only upon submission by the contractor to the manufacturer valid pressure/leak test documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.
6. Where indicated on the drawings that a Plenum-rated Piping System is needed, the pipe shall be wrapped and/or insulated with standard fiberglass or mineral wool pipe insulation, field installed, with bare fittings no closer than every 6 ft. of pipe. The pipe, wrap or insulation as a system shall meet the requirements of CAN/ULC-S102.2-03 or ASTM E84. The system shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.
7. Where indicated on the drawings that the pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, UV-resistant coating or alternative UV protection
8. Note: If Aquatherm piping is used, the Contractor must include the purchase of one set of fitting and installation tools required for additional work and modification for all pipe, fitting, and valves sizes applicable for the project, and deliver tool(s) to the Owner for future work. The Contractor shall also provide a minimum of four (4) hours of polypropylene pipe system installation and training with a certified Aquatherm representative present. Contact Cindy Zatto, VE Sales, 810-343-2713.
9. Manufacturers: AquaTherm. No substitutions. Contact Engineer for Voluntary Alternates.

2.5 IN-SLAB AND UNDERFLOOR PEX-A PIPING SYSTEMS

- A. Performance Requirements: PEX-a piping and fittings shall meet the following pressure and temperature ratings:
 1. 200 degrees F (93 degrees C) at 80 psi (551 kPa).
 2. 180 degrees F (82 degrees C) at 100 psi (689 kPa).
 3. 73.4 degrees F (23 degrees C) at 160 psi (1,102 kPa).
- B. Plastic Pipe and Fittings:
 1. PEX-a (Engle-method Crosslinked Polyethylene) Piping, ASTM 876 with oxygen-diffusion barrier that meets DIN 4726.
 2. PEX-a Fittings, Elbows and Tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - a. UNS No. C69300 Lead-free (LF) Brass.
 - b. 20 percent glass-filled polysulfone as specified in ASTM D6394.
 - c. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D6394.

- d. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D6394
 - e. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D6394.
 - f. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".
3. PEX-a Fittings (1 inch through 4 inch nominal pipe size): SDR9 compression type fitting consisting of a double O-ring insert with a compression sleeve tightened around the pipe and insert.
- C. Manifolds (commercial, HDPE or copper, valved).
- 1. Install 2" high-density polyethylene (HDPE) or copper manifolds as shown on snowmelt manifold detail, manufactured from polyethylene (PE 3408) and offered by the respective PEX tubing manufacturer for system compatibility.
 - a. Manifold body pressure and temperature ratings are in accordance with ASTM D3350.
 - b. Manifold body dimensional tolerances are in accordance with ASTM D3035.
 - c. Manifold body is manufactured to a SDR of 11.
 - 2. Install HDPE or copper manifolds in direct-burial applications.
 - 3. Manifolds approved for use in systems free of ferrous materials, or isolate ferrous material to eliminate corrosion damage due to oxygen diffusion.
 - 4. Manifolds applicable for systems operating up to a maximum of 140 degrees F (60 degrees C) at 80 psi (551 kPa).
 - 5. Balancing
 - a. Design individual loop lengths across the manifold within 10 percent of each other in length. See plans.
 - b. Provide manifold pump with equal supply and return connection length, and return-side balance valve. See plans for additional design information.
 - c. For each manifold pair tubing connection include return-side balance valves with supply side isolation valve on each loop. Supply side balance valves with return-side isolation valves are also acceptable.
 - 6. Manifold tubing outlets must feature ¾ inch or 1 inch Uponor ProPEX fittings (or Rehau equal) pressed onto the manifold outlet nipple by the manifold manufacturer.
 - 7. Include indoor steel, powder-coated manifold boxes where noted, or outdoor composite concrete or HDPE underground service boxes. Underground boxes must meet traffic weight requirements, and be labeled "snowmelt".
- D. Manufacturers:
- 1. Uponor ProPEX system.
 - 2. Rehau EVERLOC system.
 - 3. All others by Voluntary Alternate contingent on PEX-a manufacturing process and approved snowmelt manifold size and construction.

2.6 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn; using one of the following joint types:
- 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B 32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material and mechanical couplings.

3. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

2.7 PIPE HANGERS AND SUPPORTS

- A. Conform to ASME B31.9.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
- C. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
- D. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
- E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- F. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
- G. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
- H. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
- I. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- J. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- K. Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- L. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- M. Oversize all hangers with shields on insulated chilled water piping.

2.8 UNIONS, FLANGES, AND COUPLINGS

- A. Unions for Pipe 2 Inches (50 mm) and Under:
 1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
- B. Flanges for Pipe Over 2 Inches (50 mm):
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 1. Dimensions and Testing: In accordance with AWWA C606.
 2. Housing Material: Malleable iron or ductile iron, galvanized.
 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

- D. Polypropylene Piping System: Valves shall be manufactured in accordance with the manufacturer's specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11. The valves shall contain no rework or recycled thermoplastic materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Valves shall be Aquatherm® available from Aquatherm, NA. Valve specifications and ordering information are available at www.aquatherm.com.

2.9 GLOBE OR ANGLE VALVES

- A. Up To and Including 2 Inches (50 mm):
1. Bronze body, bronze trim, screwed bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, solder ends.
- B. Over 2 Inches (50 mm):
1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.10 BALL VALVES

- A. Up To and Including 2 Inches (50 mm):
1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.
- B. Over 2 Inches (50 mm):
1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.11 BUTTERFLY VALVES

- A. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
- B. Disc: Aluminum bronze.
- C. Operator: 10 position lever handle.

2.12 SWING CHECK VALVES

- A. Up To and Including 2 Inches (50 mm):
1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.
- B. Over 2 Inches (50 mm):
1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.13 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.14 FLOW CONTROLS

- A. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa kPa).

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Polypropylene Piping:
 - 1. Installers shall be trained and certified to install the pipe according to the manufacturer's guidelines. Contact your local Aquatherm representative for training.
- F. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- G. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for additional requirements.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and to avoid interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange to drain at low points.
- F. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Polypropylene Piping:

1. Install listed pipe materials and joining methods below in the following applications:
 - a. Underground Piping: Polypropylene (PP-R) piping in SDR 7.4, 9, 11, or 17.6 per manufacturer's instructions and ASTM D2774.
 - b. Aboveground: Polypropylene (PP-R) piping in SDR 7.4, 9, 11, or 17.6 based on the required minimum pressure rating and use temperature, in accordance with manufacturer's instructions and ASTM F2389.
 - c. Installation must be accomplished with the proper tools for installing Aquatherm piping following manufacturer's instructions. Installation tools are available from your local Aquatherm representative. Tools may be purchased or rented.
2. Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer's specifications and product standards.
3. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.
4. Prior to joining, the pipe and fittings shall be prepared in accordance with ASTM F 2389 and the manufacturer's specifications.
5. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.
6. Fire stopping shall be provided to both be compatible with the Aquatherm Piping and meet the requirements of ASTM E 814 or ULC S115, "Fire Tests of Through-Penetration Firestops". Pipe insulations or fire resistive coating shall be removed where the pipe passes through a fire stop and, if required by the firestop manufacturer, for 3 inches beyond the firestop outside of the fire barrier.
7. When installed in systems with pumps in excess of 7.5 HP, piping shall be protected from excessive heat generated by operating the pump at shut-off conditions. Where the possibility exists that the pump will operate with no flow, the protection method shall be a temperature relief valve or comparable level of protection, set to a maximum temperature of 185°F.
8. If heat tracing or freeze protection is specified for the piping, it should be installed on the pipe interior or exterior. It must be suitable for use with plastic piping and be self-regulating to ensure that the surface temperature of the pipe and fittings will not exceed 70°C (158°F).

H. Snowmelt Tubing:

1. Slab-on-grade Construction with Edge and Under-slab Insulation
 - a. When using high-density foam insulation board, with 6"x 6" grid steel mesh suspended 1" above insulation. Cable tie tubing to the steel mesh. See snowmelt details on plans for additional data.
 - b. The structural engineer determines the vertical compressive strength of the high-density foam insulation board. The snow-melt design determines the required insulation resistance value (R-value).
 - c. Install the vertical edge insulation along the perimeter of the slab and down to a depth equal to the bottom of the horizontal under-slab insulation.
 - d. The snow-melt design specifies the tubing on-center distance(s) and loop lengths. See plans for 9" O.C. or 12" O.C. designated snowmelt areas.

- e. Do not install tubing closer than 6 inches (152mm) from the edge of the heated slab.
 - f. Install the tubing at a consistent depth below the surface elevation as determined by the project engineer. Tubing installation will ensure sufficient clearance for all control joint cuts.
 - g. Expansion joints.
 - i. In areas where tubing must cross metal expansion joints that occur in the concrete, the tubing shall pass below the metal expansion joints.
 - ii. Fibrous expansion joints may be penetrated following the PEX tubing manufacturer's and structural engineer's recommendation.
 - h. Metal or plastic bend supports will be used to support the tubing when departing from the slab in a 90 degree bend.
- I. Pressure Testing: While still accessible, prior to insulation installation, all piping shall be pressure/leak tested to applicable standards and Codes, and per manufacturer installation requirements for acceptance and warranty.
- 1. Tests shall be carried out using water, compressed air or a mixture of the two. The test pressure shall be as indicated in the pressure leak testing procedures required by the pipe manufacturer.
 - 2. Test pressure shall be not less than 100 psi.
 - 3. Pressure test duration shall be no less than 15 minutes.
 - 4. Repair all piping, valves, and fittings that fail the pressure test, and retest system.
 - 5. Polypropylene: Any leaks detected shall be repaired at the contractor's expense by removing the leaking part and replacing with new parts welded per the pipe manufacturer's guidelines. See www.aquatherm.com for additional details and forms.
 - 6. Perform pressure test for mechanical inspector for all radiant and snowmelt tubing. Test per tubing manufacturer recommendations and Code requirements.
- J. Inspecting and Cleaning
- 1. The pipes shall be flushed with cold water after finishing the installation. Flush the system until the water runs clear of debris and dirt.
 - 2. Inspect and test piping systems following procedures of authorities having jurisdiction and as specified by the piping system manufacturer.
 - 3. Clean and disinfect water distribution piping following procedures of the manufacturer and/or the authority having jurisdiction.

3.3 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
- 1. 1/2 inch (15 mm) and 3/4 inch (20 mm): Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6 mm).
 - 2. 1 inch (25 mm): Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6 mm).
 - 3. 1-1/2 inch (40 mm) and 2 inch (50 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
 - 4. 2-1/2 inch (65 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
 - 5. 3 inch (80 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).
 - 6. 4 inch (100 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 1/2 inch (13 mm).

B. Hanger Spacing for Steel Piping.

1. 1/2 inch (15 mm), 3/4 inch (20 mm), and 1 inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6 mm).
2. 1-1/4 inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
3. 1-1/2 inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
4. 2 inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).
5. 2-1/2 inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9 mm).
6. 3 inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9 mm).
7. 4 inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

C. Hangers for Polypropylene Piping:

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
 - a. Adjustable, steel clevis hangers.
 - b. Clamps on strut trapeze.
 - c. Clamps on strut attached to structure.
 - d. Clamps attached directly to the structure.
3. Base of Vertical Piping: MSS Type 52, spring hangers.
4. Support vertical piping and tubing at base and at each floor. For piping 2" (63mm) or smaller, install mid-story guides.
5. Install hangers and supports at intervals specified in the applicable Plumbing Code and/or as recommended by pipe manufacturer.
6. Hangers and supports shall also be provided within 1-foot of every change of direction and within 1-foot of any pipe fittings and valves.
7. For hot water piping, provide clamps and supports that are felt or rubber/vinyl coated or lined.
8. For cold water piping supports and clamps may be bare metal. Ensure that the clamp or support does not have sharp edges that may scrape or gouge the piping.
9. Use care when installing riser clamps to not over tighten the clamps to cause indentation of the pipe. Riser clamps shall be isolated from the building structure by placing felt or rubber pads between the clamp and the structure.
10. All piping support materials shall be new and manufactured for the specific purpose of supporting systems, equipment, pipes and accessories. No improvised pipe support solutions shall be allowed.
11. Piping systems shall not have direct contact with the building structure. Provide isolation at tub and shower valves and pipes passing through studs, joists or plates. Use iron pipe sizes to fit Aquatherm pipe. Acceptable manufacturers for pipe/structure isolation:
 - a. Holdrite
 - b. Oatey
 - c. Sioux Chief.

D. Expansion and Contraction

1. Provide expansion and contraction controls, guides and anchors to absorb the expansion and contraction of the pipe. Provide expansion loops or other approved

method including flexible hose, slip joints, flexible ball joints, metal bellows, or rubber expansion joints as required by Code, and as indicated in the piping system manufacturer's literature.

2. Polypropylene Piping: While Aquatherm® MF® or MF®RCT® (faser) piping can absorb most of their own expansion stresses, this can cause the pipe to bow or bend.
 - a. Install anchor points at least every 120 feet.
 - b. Install expansion loop or offset between each anchor point. Expansion device must be able to absorb all the stresses between the two anchor points. Refer to manufacturer's published instructions, formulas and calculations at www.aquatherm.com.
 - c. Non-MF® pipes used for hot applications shall have expansion controls every 30 feet of straight runs.
 - d. Vertical risers of MF® piping shall be anchored at each floor.
 - e. Provide anchor point at branch take-off in vertical riser of MF® piping.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: (See plans for types of pumps required for this project)
 - 1. System lubricated circulators.
 - 2. In-line circulators.
- B. Related Sections:
 - 1. Section 232116 - Hydronic Piping Specialties: Product and execution requirements for piping specialties installed in hydronic systems adjacent to pumps.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide pumps to operate as Scheduled.

1.4 SUBMITTALS

- A. See General Requirements and Mechanical HVAC General Requirements Submittal Procedures: Submittal procedures.
- B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. See Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

- C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum ten years' documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. See Administrative Requirements: Pre-installation meeting.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. See Product Requirements: Product storage and handling requirements.
- B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. See General Requirements - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer's warranty for pumps.

1.11 EXTRA MATERIALS

- A. See Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one sets of cartridges for each side-stream filter.

PART 2 - PRODUCTS

2.1 SYSTEM LUBRICATED CIRCULATORS

- A. Manufacturers:
 1. Bell and Gossett
 2. Grundfos
 3. Taco
 4. Armstrong
 5. All others by Voluntary Alteranate
- B. Furnish materials in accordance with AHJ standards.
- C. Type: Horizontal shaft, single stage, direct connected with multiple speed wet rotor motor for in-line mounting, for 140 psig (965 kPa) maximum working pressure, 230 degrees F (110 degrees C) maximum water temperature.

- D. Casing: Cast iron with flanged pump connections.
- E. Impeller, Shaft, Rotor: Stainless Steel.
- F. Bearings: Metal Impregnated carbon (graphite) and ceramic.
- G. Motor: Impedance protected, single, multiple speed, or variable speed as Scheduled.
- H. Performance:
 - 1. See Pump Schedule.
- I. Electrical Characteristics and Components:
 - 1. Electrical Characteristics: Voltage and phase as Scheduled and matching available power.
 - a. Motor 1.15 percent minimum power factor at rated load.
 - 2. Motors: UL rated, Open Drip Proof or TEFC as Scheduled.

2.2 IN-LINE CIRCULATORS

- A. Manufacturers:
 - 1. Bell and Gossett
 - 2. Grundfos
 - 3. Taco
 - 4. Armstrong
 - 5. All others by Voluntary Alternate.
- B. Furnish materials in accordance with AHJ standards.
- C. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psig (860 kPa) maximum working pressure.
- D. Casing: Cast iron, with flanged pump connections.
- E. Impeller: Cadmium plated steel or Stamped brass or cast bronze keyed to shaft.
- F. Bearings: Two, oil lubricated bronze sleeves.
- G. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.
- H. Seal: Carbon rotating against stationary ceramic seat, 212 degrees F maximum continuous operating temperature.
- I. Drive: Flexible coupling.
- J. Performance:
 - 1. See Pump Schedule.
- K. Electrical Characteristics and Components:
 - 1. Electrical Characteristics: Voltage and phase as Scheduled and matching available power.
 - a. Motor 1.15 percent minimum power factor at rated load.
 - 2. Motors: UL rated, Open Drip Proof or TEFC as Scheduled.

2.3 VERTICAL IN-LINE PUMPS

- A. Manufacturers:
 - 1. Bell and Gossett
 - 2. Grundfos
 - 3. Taco
 - 4. Armstrong
 - 5. All others by Voluntary Alternate.
- B. Furnish materials in accordance with AHJ standards.
- C. Type: Vertical, single stage, close coupled, radial [or horizontally] split casing as Scheduled.
- D. Casing: Cast iron with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
- E. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
- F. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
- G. Shaft Sleeve: Aluminum bronze.
- H. Seal: Carbon rotating against stationary ceramic seat, 250 degrees maximum continuous operating temperature.
- I. Performance:
 - 1. See Pump Schedule.
- J. Electrical Characteristics and Components:
 - 1. Electrical Characteristics: Voltage and phase as Scheduled and matching available power.
 - a. Motor 1.15 percent minimum power factor at rated load.
 - 2. Motors: UL rated, Open Drip Proof or TEFC as Scheduled.
- K. Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing, for 125 psi (860 kPa) maximum working pressure.
- L. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- M. Impeller: Bronze, fully enclosed, keyed to shaft.
- N. Bearings: Oil lubricated roller or ball bearings.
- O. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- P. Seal: Mechanical seal, 225 degrees F (107 degrees C) maximum continuous operating temperature.
- Q. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 250 degrees F (121 degrees C) maximum continuous operating temperature.

- R. Drive: Flexible coupling with coupling guard.
- S. Baseplate: Cast iron or fabricated steel with integral drain rim.
- T. Motors: Energy efficient; ODP; inverter / VSD duty.

2.4 BASE MOUNTED PUMPS

- A. Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing, for 125 psi (860 kPa) maximum working pressure.
- B. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed to shaft.
- D. Bearings: Oil lubricated roller or ball bearings.
- E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- F. Seal: Mechanical seal, 225 degrees F (107 degrees C) maximum continuous operating temperature.
- G. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 250 degrees F (121 degrees C) maximum continuous operating temperature.
- H. Drive: Flexible coupling with coupling guard.
- I. Baseplate: Cast iron or fabricated steel with integral drain rim.
- J. Motors: Energy efficient; ODP; inverter / VFD duty.

2.5 HIGH EFFICIENCY ELECTRICALLY COMMUTATED MOTOR (ECM) WITH INTEGRAL VARIABLE SPEED DRIVE

- A. Type: ECM Motor, variable speed, with integral controller with pre-programmed flow control sequences.
- B. Casing: Cast iron (or lead-free bronze for potable systems as scheduled).
- C. Impeller: Poly-phenylene sulfide or stainless steel.
- D. Shaft: AISI 420 stainless steel.
- E. Rotor: permanent magnet.
- F. Bearings: Carbon sleeve.
- G. Gasket: EPDM O-ring.

- H. Wetted Parts: AISI 304 stainless steel.
- I. Motor Type: ECM / permanent motor insulation Class F.
- J. Controller: integral, selectable, pre-programmed pressure and temperature controls.
- K. Pressure: 175 psi.
- L. Temperature: 14F – 230F.
- M. Flow Characteristics: See Pump Schedule.
- N. Voltage: See Pump Schedule (115v, 208-230v).

2.6 Not Required for this Project: SIDE-STREAM FILTRATION SYSTEM

- A. Manufacturers:
 1. Shelco Corporation
 2. Contact Engineer for other approvals.
 3. Final Filter Housing and Filters selected by Water Chemical Specialist.
- B. Furnish materials in accordance with AHJ standards.
- C. System: Flow indicator, filter housing with cartridge filter, shut-off valves, and flow control valve.
- D. Performance: Design flow minimum 10 percent of total system flow.
- E. Filter Housing: Commercial/industrial heavy duty 304L stainless steel housing, with bolt-nut filter access, flanged connections, Buna-A seals, sized for required flowrate and Water Chemical Specialist.
- F. Hot Water Filter: Glass reinforced nylon plastic suitable for 220 degrees F (105 degrees C) and 200 psig (1380 kPa) operating conditions.
- G. Cartridges: 50 micron (0.03 mm) for start-up and 10 micron (0.01 mm) for system operation, or as recommended by Water Chemical Specialist.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.

- C. Install pumps on vibration isolators. Refer to Section 230548.
- D. Install flexible connectors at inlet and outlet of pumps as shown on Drawing schematics, schedules, and details.
- E. Provide line sized shut-off valve and suction diffuser, isolation valves, circuit setters, check valves, or triple-duty valves as shown on Drawing schematics and details.
- F. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches (100 mm) and larger.
- G. Provide air cock and drain connection on horizontal pump casings.
- H. Provide drains for bases and seals.
- I. Check, align, and certify alignment of base mounted pumps prior to start-up.
- J. Install base mounted pumps on concrete housekeeping base or inertia bases, with anchor bolts, set and level, and grout in place.
- K. Lubricate pumps before start-up.
- L. Not Required for this Project: Provide side-stream filtration systems as noted on Drawings, schematics, schedules, or details. systems. Install across pump with flow from pump discharge to pump suction from pump taps.
- M. Install Work in accordance with AHJ standards.

3.2 FIELD QUALITY CONTROL

- A. See Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect for alignment of base mounted pumps.
- C. Verify proper pump rotation prior to Test and Balance.

END OF SECTION

SECTION 23 31 00
HVAC DUCTWORK AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ductwork.
- B. Flexible ductwork.

1.2 RELATED REQUIREMENTS

- A. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

1.3 REFERENCE STANDARDS

- A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.
- B. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2007a.
- C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association; 2008.
- D. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 1985, First Edition.
- E. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.
- F. ASHRAE 90.1-2013 Duct Leakage Classification.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.5 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

Where applicable to duct design on plans:

- A. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z180 coating.
- B. **Not Applicable to this Project:** Exposed spiral ductwork shall be select, shiny, G-90 galvanized spiral duct, or as is specified to be painted, shall include paint grip (galvaneal) for painting by others.
- C. Steel Ducts: ASTM A 1008/A 1008M, Designation CS, cold-rolled commercial steel.
- D. **Not Applicable to this Project:** Grease-Laden Ductwork:
 - 1. Type 1, as defined by International Mechanical Code.
 - 2. Constructed of 16 gage steel with welded joints or 18 gage stainless steel welded duct.
 - 3. Factory-built listed and labeled, round, insulated, double-walled, zero clearance, UL-1978.
- E. Insulated Flexible Ducts:
 - 1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
 - a. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
 - b. Maximum Velocity: 4000 fpm (20.3 m/sec).
 - c. Temperature Range: -10 degrees F to 160 degrees F (-23 degrees C to 71 degrees).
 - d. UL 181.
- F. **Not Applicable to this Project:** Underground Ductwork:
 - 1. Polyvinyl Chloride PCD
 - 2. Reinforced, standing seam, riveted, spiral ductwork, structurally design and tested to withstand direct burial.
 - 3. 4x1 (inner galvanized, outer 4 mil PVC coating) for underground ductwork.
- G. **Not Applicable to this Project:** Fume Exhaust Ductwork
 - 1. Polyvinyl Chloride PCD
 - 2. Standing seam, riveted, spiral ductwork, slip fit, or flanged as noted herein or on plans.
 - 3. 4 x4 (4mil inner PVC coating and 4 mil outer PVC coating) for corrosive fume ductwork.
- H. Joints and Seams: Listed and labeled UL 181 A-P, UL A-M, UL 181A, UL 181B, UL 181B-FX, UL 181B-M.
 - a. Hardcast Versa 181 Duct Sealant, 5-year warranty.
 - b. Hardcast 321, exterior, UV resistant, duct sealant, 5-year exterior warranty.
 - c. Hardcast AFT Rolled Mastic Pressure Sensitive Tape, UL 181B, 10-year warranty.
 - d. Hardcast TPO-2265 exterior (exposed) TPO pressure sensitive tape, UL 181, ASTM D822.
- I. Exterior Duct Jacket
 - 1. Venture Clad 1577CW exterior duct jacket, -30F to +300F, 6.0 mils, 0.000 Perms. UL Classified. PSTC 101, PSTC 107, PSTC 131, ASTM D 1000, ASTM D 624, ASTM E 162, ASTM E 622, ASTM E 96.

- J. Non-metallic, Class 0 or Class 1 fibrous duct board, complying with UL 181 is not approved for this project.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Provide turning vanes for all ductwork 12"x12" in size or greater in size.
- C. Provide turning vanes in all high pressure / high velocity VAV cold air main ductwork on transitions greater than 45 degrees (unless specifically listed as radiused).
- D. Construct standard radiused elbows with inside radius 1/2 times of width, and outside radius 3-1/2 times the inside radius.
- E. Increase duct sizes gradually, not exceeding 30 degrees divergence wherever possible.
- F. All Type 1 welded grease duct transitions greater than 45 degrees shall be mitered with no less than 30 degree divergence. Where this is not possible up to 45 degree divergence may be used, and include a clean-out upstream of the transition. No non-mitered transitions greater than 45 degrees are allowed.
- G. Type 1 grease duct systems shall be constructed and installed in strict accordance with the International Mechanical Code.
1. Cleanouts:
 - a. Must be installed within 10 feet of all mitered 90 degree transitions.
 - b. Cleanouts in horizontal duct must be installed not more than 20 feet of apart.
 - c. Cleanouts shall not be closer than 1" from edges of duct.
 - d. Cleanouts shall be not less than 12"x12" in dimension. For ductwork less than 16" deep or wide cleanouts shall be not less than 12" in the long direction, and large enough to provide access and cleaning.
 - e. Cleanouts shall be installed on inlet and outlet of all Type 1 in-line exhaust fans.
 2. All ductwork shall be sloped to a cleanout or to the grease hood to allow cleaning.
- H. Exterior Ductwork shall be constructed in one of the following methods:
1. Galvanized ductwork wrapped (on exterior) with 1-1/2" polyisocyanurate (R-8 minimum) rigid insulation, and lined with 3/4" (or thickness as listed on plans), mechanically fastened duct liner (for sound). Seal ductwork using Hardcast Versa Grip 181 or Hardcast ATF-701 aluminum exterior grade pressure tape. Wrap exterior rigid insulation with Ventureclad 1577 CW ductwrap sealed using 1577 CW tape.
 2. Galvanized interior ductwork lined with 2" mechanically fastened duct liner (minimum R-6 per ASHRAE 90.1-2013) sealed with Hardcast 321, and jacketed with gray Ventureclad 1577 CW exterior duct jacket. Install and seal jacket using Ventureclad 1577 CW tape.
 3. Contact Engineer for other approved exterior duct construction methods.

- I. Fibrous duct board is not approved for this project.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Line first 10 feet of supply and return main ductwork connected to air handling systems, or where shown on plans. Line with minimum 1/2" thick duct liner or thickness as specified on plans. Interior dashed lines shown on ductwork indicated where additional duct liner is required.
- D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- D. Maximum flex duct length is 8'-0" in length, or as shown on plans. Flex duct shall not be used above inaccessible ceilings, unless specifically approved by Engineer. Flex duct shall be connected using heavy duty cable ties, or metallic mechanical strapping.
- E. Install all Type 1 and Type 2 ductwork in strict accordance with the 2015 Michigan Mechanical Code, or Mechanical Code currently enforced by the Authority Having Jurisdiction.
- F. Exterior ductwork shall be installed using one of the methods described above. Install ductwork above ground and snow levels. Protect additional protection at locations of eave or roof water run-off, or ice damn or icicle fall. Provide galvanized strut and support fastened to concrete housekeeping pads, above-ground piers, or exterior walls. Support and install per SMACNA exterior duct installation standards and guidelines.
- G. Coordinate installation of buried ductwork with building footings. Terminate PCD ductwork into below grade CMU or poured concrete footings.
- H. **Not Applicable to this Project:** Penetrate walls, plenum walls, and foundation walls per Acoustical Engineering Specifications. Wall penetrations for large ductwork shall be a minimum 3/4" larger than exterior duct diameter, and shall be packed with mineral fiber insulation, and caulked and sealed using acoustical sealant and backer rod.
- I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

END OF SECTION

SECTION 23 33 00

AIR DUCTWORK ACCESSORIES

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. Manual volume control dampers.
 2. Flexible Connectors
 3. Turning vanes.
 4. Duct-mounted access doors and panels.
 5. Accessories hardware.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data including details for materials, dimensions of individual components, profiles, and finishes for each of the duct accessory types.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA Standards:
- B. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- C. NFPA 91, "Standard for the Installation of Blower and Exhaust Systems".

1.5 EXTRA MATERIALS

- A. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 PRODUCTS

2.1 MANUAL VOLUME CONTROL DAMPERS

- A. General: Provide field-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide 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. Construct in accordance with SMACNA "HVAC Duct Construction Standards".

2.2 **Not Applicable to this Project:** FIRE DAMPERS

- A. General: UL labeled according to UL Standard 555 "Standard for Fire Dampers."
- B. Fire Rating: 1-1/2 or 3 hours, as indicated.
- C. Frame: Where space allows use Type b otherwise type A. Type B; fabricated with roll-formed, 21-gage, galvanized-steel; with mitered and interlocking corners.
 - 1. Mounting Sleeve: Factory-installed or field-installed galvanized steel.
 - 2. Minimum Thickness: 0.056-inch (16-gage) or 0.138-inch (10-gage) thick as indicated, and length to suit application.
- D. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of the wall or floor, and thickness of damper frame meets sleeve requirements.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 21-gage galvanized steel. In place of interlocking blades, provide full-length, 21-gage, galvanized-steel blade connectors.
- G. Horizontal Dampers: Include a blade lock and stainless steel negator closure spring.
- H. Fusible Link: Replaceable, 165 F, unless otherwise indicated or required.
- I. Manufacturer's:
 - 1. American Warming
 - 2. Air Balance Inc.
 - 3. Ruskin Mfg. Co.

2.3 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.
- B. Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.

- C. Construct turning vanes of the same material as the ducts in which they are installed. Construct turning vanes for low and medium pressure systems of 20 gauge galvanized steel or the equivalent thickness for other duct materials as shown in the specification.
- D. Turning vanes shall be double vanes as manufactured by Ductmate or approved equal or shop fabricated turning vanes constructed to the same standards. Submit samples of shop fabricated units for approval.

2.4 **Not Applicable to this Project:** FIRE/SMOKE DAMPERS

- A. General: UL-labeled according to UL Standard 555S, “Standard for Leakage Rated Campers for Use in Smoke Control Systems”. Combination fire and smoke dampers shall also be UL-labeled for 1-1/2 hour rating according to UL Standard 555 “Standard for Fire Dampers.
- B. Fusible Link: Replaceable, 165 deg. F. rated.
- C. Frame and Blades: 16-gage galvanized steel.
- D. Mounting Sleeve: Factory-installed, 18-gage galvanized steel, length to suit wall or floor application.
- E. Seals: Silicone rubber blade edge seals, stainless steel flexible compression type jamb seals.
- F. Operator: Pneumatic actuator with power open spring return (fail close) operation. Operator mounted outside of air stream with mounting bracket. Damper to be reopenable from remote location.
- G. Bearings: Stainless steel sleeve passed into frame or oil impregnated bronze.
- H. Class: 250 deg. F. temperature class; Leakage Class II.
- I. Remote blade position indicator.
- J. Manufacturers:
 1. American Warming
 2. Air Balance Inc.
 3. Ruskin Mfg. Co.

2.5 **Not Applicable to this Project:** SOUND ATTENUATORS

- A. General: Provide factory-fabricated and tested round or rectangular attenuator with performance characteristics and physical requirements as indicated.
- B. Fire Performance: Adhesives, sealers, packing material, and accessory materials shall have fire ratings not exceeding 25 for flame spread and 50 for smoke developed when tested according to ASTM E 84, “Standard Test Method for Surface Burning Characteristics of Building Materials.”
- C. Rectangular Units: Fabricate casings with a minimum of 22-gage solid sheet metal for outer casing and 26-gage perforated sheet metal for inner casing.

D. Round Units: Provide casings with sheet metal thicknesses for the casing diameters as listed below:

<u>Up to 24 inches:</u>	22 gage
<u>26 through 40 inches:</u>	20 gage
<u>42 through 52 inches:</u>	18 gage
<u>54 through 60 inches:</u>	16 gage

- E. Casings fabricated of spiral lock seam duct may be 2 gages lighter than that indicated.
- F. Interior Partitions and Baffles: At least 22 gage, and designed for minimum aerodynamic losses.
- G. Sheet Metal Perforations: 1/8 - inch diameter for inner casing and baffle sheet metal.
- H. Fibrous Acoustic Fill Material: Inert and vermin-proof fibrous material with density to obtain specified acoustic performance. Pack under not less than 5 percent compression to eliminate voids due to vibration and settling.
- I. Fabricate attenuators to form rigid units that will not pulsate, vibrate, rattle or otherwise react to system pressure variations.
 - 1. Do not use nuts, bolts, and sheet metal screws for unit assemblies.
 - 2. Lock form and seal or continuously weld joints.
 - 3. Suspended Units: Provide factory-installed suspension hooks or lugs attached to the frame in quantities and spaced to prevent deflection or distortion.
 - 4. Reinforcement: Provide cross angles or trapeze angles for rigid suspension.
- J. Source Quality Control: Perform the following factory tests:
- K. Acoustic Performance: Test silencers with airflow in both directions through attenuator, according to ASTM E 477, "Methods of Testing Duct Liner Materials and Prefabricated Silencers for Acoustical and Airflow Performance."
- L. Record acoustic ratings, including dynamic insertion loss and self-noise power levels for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with an airflow of at least 2,000 FPM face velocity.
- M. Leak Test: Test units for airtightness at 200 percent of the associated fan static pressure or 6-inch W.G. static pressure, whichever is greater.
- N. Manufacturers:
 - 1. Titus Products
 - 2. Rink Sound Control
 - 3. United McGill
 - 4. Industrial Acoustics
 - 5. Aerosonics
 - 6. Dynasonics

2.6 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with

UL Standard 181, Class 1.

- B. Standard Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 2-3/4 inch wide, 24-gage, galvanized sheet steel or 0.032-gage aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.
- C. Conventional, Indoor System Flexible Connectors Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz. per sq. yd.
 - 2. Tensile Strength: 480 lb. per inch in the warp and 360 lb. per inch in the filling.
- D. Manufacturers:
 - 1. American/Elgen
 - 2. Duro-Dyne
 - 3. Flexaust
 - 4. Vent Fabrics

2.7 **Not Applicable to this Project:** DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Refer to the Access Door Materials Schedule at the end of this Section for frame and door thickness, number of hinges and locks, and location of locks. Provide construction and airtightness suitable for duct pressure class.
- B. Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness, number of hinges and locks as indicated for duct pressure class. Provide vision panel where indicated. Provide 1-inch by 1-inch butt hinge or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.
- E. Insulation: 1-inch thick fiber glass or polystyrene foam board.
- F. Doors in Round or Oval Duct: shall be made for that purpose.

2.8 ACCESSORIES HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket and a flat mounting gasket. Size to allow insertion of pitot tube and other testing instruments and provide in length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket, 1/4-inch, zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline and grease.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards. Provide volume damper at every take off from any duct.
- B. Install volume control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to the manufacturer's UL-approved printed instructions.
- E. Install fusible links in fire dampers.
- F. Label access doors according to Division 15 Section "Mechanical Identification."
- G. Provide access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, fire dampers, smoke dampers and elsewhere as indicated.
- H. Install turning vanes in square or rectangular 90 deg. elbows in supply and exhaust air systems, and elsewhere as indicated.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

3.4 ACCESS DOOR MATERIALS SCHEDULE

- A. Install access panels in strict accordance to the currently enforced Mechanical Code, SMACNA Duct Standards, and the AHJ:
- B. Duct Pressure Class:
 - 1. Rated for four inches water gage on all:
 - a. Variable air volume (VAV) high pressure cold air supply air (HP CA) ductwork.
 - b. VAV system return air (RA) main ductwork.
 - c. Smoke purge – return air and smoke purge exhaust air ductwork.
 - 2. Rated for two inches water column

- a. On all ductwork downstream of VAV boxes, secondary return air branch ductwork, and standard exhaust ductwork: 2 inches & less.
- C. See plans for fire and smoke damper access panel sizes. Where not listed provide minimum sizes listed below:

Door Size: 12"x12"
No. Of Hinges: 2
No. Of Locks: 1 - Side
Metal Gages:
 Frame: 24
 Door: 22
 Back: 26

Door Size: 16"x20"
No. Of Hinges: 2
No. Of Locks: 2 - Side
Metal Gages:
 Frame: 22
 Door: 24
 Back: 26

Door Size: 24"x24"
No. Of Hinges: 3
No. Of Locks: 2 - Side
Metal Gages:
 Frame: 22
 Door: 22
 Back: 26

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. In-line Centrifugal Fans

1.3 RELATED SECTIONS

- A. The following Sections contain requirements that relate to this Section:
 - 1. Division 23 09 00 Temperature Control System
 - 2. Division 26 00 00 Electrical

1.4 SUBMITTALS

- A. General:
 - Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
- C. Certified fan performance curves with system operating conditions indicated.
- D. Certified fan sound power ratings.
- E. Motor ratings and electrical characteristics, voltage, plus motor and electrical accessories.
- F. Material gages and finishes, including color charts.
- G. Dampers, including housings, linkages, and operators.
- H. Shop Drawings:
 - 1. Shop Drawings shall be submitted as described under Division 15 General Requirements.
 - 2. Shop Drawings shall be submitted by the manufacturer supplier, detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
- I. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 1 and in Division 23 Section "Basic Mechanical Requirements."

1.5 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
- C. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.
- D. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.
- E. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- F. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.
- G. UL Standard: Provide power ventilators that comply with UL 705, UL 762, UL 793.
- H. NFPA 91: Standard for the installation of “Blower and Exhaust Systems”.
- I. NFPA 92A-06 - Recommend Practice for Smoke-Control System.
- J. NFPA 92B-05 - Standard for Smoke Management System in Malls, Atria, and Large Areas.
- K. NFPA 96-04 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cook
 - 2. Greenheck
 - 3. All others by Voluntary Alternate

2.2 CENTRIFUGAL VENTILATORS

- A. Description:
Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

- B. Housings:
 1. Upblast: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone, grease cup,
 2. Hooded: Removable, extruded-aluminum, rectangular top; square, one-piece, aluminum base with venturi inlet cone.
 3. Downflow: Removable, galvanized steel, mushroom-domed top; square, one-piece, hinged, aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Drive Assembly: Resiliently mounted to the housing, with the following features:
 1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust air stream.
 5. Belt Drive or Direct Drive as listed in the Exhaust fan Schedule.
- E. Accessories: The following items are required:
- F. Variable-Speed Controller: Where indicated on schedules or required. Provide solid-state control to reduce speed from 100 percent to less than 50 percent.
- G. Disconnect Switch: Lockable Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit. Disconnect shall be lock out type. NEMA 4x for all Type 1 outdoor mounted kitchen exhaust fans.
- H. Bird Screens: Removable 1/2-inch (13-mm) mesh, aluminum or brass wire, where applicable.
- I. Dampers: Where indicated on Exhaust Fan Schedule, Mechanical Drawings, or temperature Control Specifications include:
 1. Low pressure, gravity back draft damper, round or rectangular or square parallel blade
 2. Motorized, parallel-blade, motorized, 2-position or modulating, medium pressure
- J. Motors:
 1. Refer to Division 26 for motor requirements.
 2. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
 3. Enclosure Type: The following features are required as indicated:
 4. Open drip-proof motors where satisfactorily housed or remotely located during operation
- J. Roof Curbs:
 1. Height: 12" minimum
 2. Galvanized steel; mitered and welded corners; 2-inch (50-mm) thick, rigid, fiberglass insulation adhered to inside walls; and 2-inch (50-mm) wood nailer.
 3. Dimensions: Size as required to suit roof opening and fan base.

2.3 CABINET FANS

- A. Housing: sound insulated, galvanized housing, with mounting flange and supporting

brackets.

- B. Grille: architecturally design plastic grille, or heavy duty metal grille as listed on the Exhaust Fan Schedule.
- C. Blower: Centrifugal blower wheel with permanently lubricated bearings.
- D. Sound Rating: Sone or Noise Criteria (NC) rating as listed on the Exhaust Fan Schedule.
- E. Backdraft damper: Factory included, quiet, flap-free operation.
- F. Voltage: As listed on the Exhaust Fan Schedule.

2.4 IN-LINE CENTRIFUGAL FANS

- A. Housing: Housing shall be heavy gage galvanized steel with, removable access panels, and square mounting collars.
- B. Fan Wheel: The fan wheel shall be aluminum, centrifugal, backward inclined, statically and dynamically balanced.
- C. Fan Hub: Aluminum construction.
- D. Motors: Motors shall be heavy duty ball bearing type, matched to fan load, and furnished at specified voltage and phase. Motor and drive shall be mounted out of air stream.
- E. Fan Shaft: Fan shaft shall be precision ground and polished steel, permanently sealed, lubricated pillow block ball bearings. Bearing life shall be 200,000 hours.
- F. Pulleys, Sheaves, and Belts: Pulleys shall be cast iron, keyed, and securely attached to wheel and motor shaft. Pulleys shall be adjustable for balancing. Sheaves and belts shall be provided to match design airflow.
- G. Disconnect: A NEMA 1 disconnect shall be included with fan.
- H. Fan shall bear AMCA Seal, and shall be UL Tested.
- I. Accessories: All fans shall include horizontal or vertical vibration isolators as needed for designed installation. If listed on the Exhaust Fan Schedule, include speed controller and or insulation.
- J. Noise Rating: Sone rating shall be equal to or less than that listed on the Exhaust Fan Schedule.

2.5 **Not Applicable to this Project:** SMOKE PURGE EXHAUST FANS

- A. Fans shall UL listed as “Power Ventilators for Smoke Control Systems” (by maximum temperature for a minimum number of hours of operation) for one of the following.
 - 1. 500°F (260°C) maximum temperature for a minimum of 4 hours of operation.

2. 572°F (300°C) maximum temperature for a minimum of 2 hours of operation.
 3. The UL Power Ventilators for Smoke Control sticker shall be fixed to the fan housing.
- B. Fans shall be provided to match requirements as Scheduled and approved by the Engineer.
 - C. Outdoor roof mounted smoke purge fans shall be roof-mounted mixed flow upblast, belt drive with motor cover fully welded construction, heavy gage curb cap, butterfly damper, and windband. HTUL, UL/ULc – HT, Class 1.
 - D. Indoor smoke purge fans shall be mixed flow direct-drive, in-line mixed flow, with OSHA motor guard, HTUL, UL/ULc-HT, Class 1.
 - E. Base fan performance at standard conditions (density 0.075 Lb. /ft³).
 - F. Fans selected shall be capable of accommodating static pressure and flow variations of +/- 15% of scheduled values.
 - G. Each fan shall be belt drive in AMCA arrangement 9.
 - H. Fans are to be equipped with lifting lugs.
 - I. After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permator (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.
 - J. Fan Housing and Outlet:
 1. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
 2. Tubular fan housing shall be completely welded and coated with a minimum of 2-4 mils of Permator (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. No uncoated metal fan parts will be allowed.
 3. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.
 4. All mixed flow housings shall include welded steel vanes to straighten airflow prior to exiting the fan discharge.
 5. Units up to size 27 shall incorporate a universal mounting system that allows the fan to be mounted in either vertical or horizontal configurations and field rotation of the motor position in 90 degree increments. Bearing life shall not be reduced below specified level in different configurations. Units size 30 and larger shall allow for field rotation of motor positions. Units shall accommodate base mount or ceiling hung mounting without structural modifications to the fan.
 6. An access door shall be supplied for impeller inspection and service.
 7. OSHA compliant belt guard or motor cover to be included to completely cover the motor pulley and belt(s).
 - K. Fan Impeller
 1. Fan impeller shall be mixed flow design. The impeller shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.

2. Fan impeller shall be manufactured with continuously welded steel airfoils and coated with a minimum of 2-4 mils of Permator (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey.
3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

L. Fan Motors and Drive

1. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 RPM, Totally Enclosed Fan Cooled (TEFC), Explosion Proof (EXP) as Scheduled, with a 1.15 service factor, inverter rated.
2. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.
3. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.
4. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.
5. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.
6. Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class {Average Life or (L-50) of 400,000 hours} [(L-10) of 200,000 hours at maximum operating speed for each pressure class {Average Life or (L-50) of 1,000,000 hours}],.
7. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.
8. Bearings shall have extended lube lines with Zerk fittings to allow for lubrication.
9. For outdoor fans: NEMA 4x outdoor corrosion and water resistance disconnect switches.
10. For indoor fans: NEMA 1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's written instructions.
- B. Install units with clearances for service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Adjusting
 1. Adjust damper linkages for proper damper operation.
 2. Adjust belt tension.
 3. Adjust sheaves
 4. Lubricate bearings.
- B. See Smoke Purge Sequence of Operations for special requirements.

3.3 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

END OF SECTION

SECTION 23 36 00

TERMINAL UNITS

1.0 GENERAL

1.1 SCOPE OF WORK:

- A. Furnish and install Terminal Units and accessories as specified in this section and as shown on Drawings.
- B. This section includes specifications for the following terminal units:
 - 1. **Not Applicable to this Project:** Hot Water Unit Heaters
 - 2. **Not Applicable to this Project:** Cabinet Unit Heaters
 - 3. Gas-Fired Unit Heaters
 - 4. **Not Applicable to this Project:** Radiant Ceiling Panels
 - 5. **Not Applicable to this Project:** Variable Air Volume Boxes
 - 6. Electric Duct Heaters

1.2 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. Requirements of the following Division 23 Sections apply to this section.
 - "Basic Mechanical Requirements"
 - "Basic Materials and Methods"
 - "Electrical Requirements for Mechanical Equipment"
- C. ARI Compliance: Test and rate coils in accordance with ARI 410; and unit ventilators in accordance with ARI 330; provide ARI Certified Ratings Seal.
- D. I-B-R Compliance: Test and rate finned radiation in accordance with I=B=R Standards.
- E. UL Compliance: Provide electrical components of terminal units which have been listed and labeled by UL. Terminal units shall be UL listed and labeled.

1.3 SUBMITTALS:

Shop Drawings:

- 1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- 2. Submit complete manufacturer's shop drawings of all equipment, accessories and controls, including capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data. Provide color swatches with Shop Drawings.
- 3. Approval of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving the mechanical contractor of basic responsibilities under all contract documents, and does not approve changes in time or cost.
- 4. After approval, the mechanical contractor and its subcontractors are responsible to

provide information to all other trades involved in, or affected by, the installation of the mechanical and plumbing equipment.

2.0 PRODUCTS

2.1 **Not Applicable to this Project:** HOT WATER UNIT HEATERS

General: Provide unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled.

- A. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- B. Casing: 0.0478 inch (1.2 mm) steel with threaded pipe connections for hanger rods.
- C. Finish: Factory applied baked primer coat enamel of color selected by Architect. Provide color swatches with Submittals.
- D. Fan: Direct drive propeller type statically and systematically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- E. Air Outlet: Adjustable pattern diffuser on projection models and { two | four } way louvers on horizontal throw models.
- F. Motor: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models.
- G. Approved Manufacturers:
 - 1. Sterling
 - 2. Modine

2.2 **Not Applicable to this Project:** CABINET UNIT HEATERS:

General: Provide cabinet unit heaters having cabinet sizes and in locations as indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coil, fanboard, fan wheels, housings, motor, and insulation.

- A. Chassis: Galvanized steel wrap-around structural frame with edges flanged.
- B. Insulation: Faced, heavy density glass fiber.
- C. Cabinet: Configuration (recessed, surface mount, floor mount etc., as Scheduled) 16-ga removable front panel, 18-ga top and side panels. Insulate front panel over entire coil section. Provide access door on coil connection side. Clean cabinet parts, bonderize, phosphatize, and flow-coat with baked-on primer and enamel finish coat, color selected by Architect.
- D. Water Coils: Construct of 5/8" seamless copper tubes mechanically bonded to configured

aluminum fins. Design for 300 psi and leak test at 300 psi under water. Provide same end connections for supply and return.

- E. Fans: Provide centrifugal, forward curved double width fan wheels constructed of non-corrosive, molded, fiberglass-reinforced thermo-plastic material. Construct fan scrolls of galvanized steel.
- F. Motors: Provide shaded pole motors with integral thermal overload protection, and motor cords for plug-in to junction box in unit.
- G. Filters: Provide 1" thick throwaway type filters in fiberboard frames.
- H. Accessories: Provide the following, as indicated and/or scheduled:
- I. Cabinet Type and Configuration: Provide surface mount, partially recessed, or fully recessed cabinet configured per Cabinet Unit Heater Schedule. Provide all kits, flanges, hangers, hardware, etc, required to properly install.
- J. Approved Manufacturers:
 - 1. Sterling
 - 2. Trane
 - 3. Modine
 - 4. McQuay

2.3 GAS-FIRED UNIT HEATERS

General: 83% high efficiency, separated combustion, power-vented gas-fired unit heaters of the style, type, capacity, and airflow as Scheduled.

- A. Cabinets: Construct of G-30 galvanized steel with exposed edges rounded. Provide removable front. Clean steel surfaces, phosphatize, and flow-coat with baked primer paint. Finish with baked enamel, standard color as selected by Architect. Provide 12-ga demountable fan board assembly. Provide continuous heavy steel bars welded in place for discharge grilles, integral with unit structure.
- B. Heat Exchanger: multi-cell, 4-pass serpentine, stainless steel heat exchanger for low ambient inlet air.
- C. Burner: natural gas, continuous would close pressed stainless-steel ribbon separating the flame from the burner interior. Single venture tube orifice supply fuel to a one-piece burner housing.
- D. Fan Assembly: Provide assembly including fans, fan housings, bearings, and fan shaft. Mount fan assembly on rubber isolators.
- E. Motors: Provide split-phase-start, capacitor-run constant speed motors.
- F. Venting: separated combustion, power venter device to draw combustion air directly from outdoors. Exhaust air venting directly to the outdoors, with concentric roof or wall cap.
- G. Accessories: Vertical and horizontal louvers, or down-turn supply air hood as Scheduled Concentric B-vent, exhaust and combustion air wall or roof termination kit.

- H. Approved Manufacturers:
 - 1. Reznor
 - 2. Modine

2.4 **Not Applicable to this Project:** MODULAR AND EXTRUDED RADIANT CEILING PANEL

General: Provide extruded radiant ceiling panel constructed of extruded aluminum panels of the required width and number of tubes as scheduled.

- A. Panel Design: Tube saddle shall be an integral part of the aluminum section. Circulation tubing shall be 5/8" OD round tubing mechanically fastened to the section. A non hardening heat transfer paste is required between the tubing and the aluminum saddle. Sections shall interlock using tongue and groove connection and be held together using aluminum cross channels with spring clips. All section interlocking to be done at the factory with return bends factory installed prior to going on site.
- B. Panel Capacity: Panel output capacity (BTU per linear foot), flowrate, and pressure drop, shall meet those values listed on the Extruded Radiant Panel Schedule.
- C. Finish: Panels shall be painted white, unless custom color is specified on the Extruded Radiant Panel Schedule.
- D. Dimensions: All extruded panels shall be the sizes as shown on the Drawings, and as called for in the Specifications. Modular radiant panels shall be designed to fit between 2x2 or 2x4 standard T-Bar lay-in ceiling frames.
- E. Insulation: All panels shall be insulated with 1" thick, 0.75 pound per cubic foot, fiberglass insulation.
- F. Approved Manufacturers:
 - 1. Sterling
 - 2. Airtite
 - 3. Sun-El

2.5 **Not Applicable to this Project:** VARIABLE AIR VOLUME (VAV) BOXES

General: VAV boxes shall be certified under ARI Standard 880 Certification Program, and carry the ARI Seal.

- A. Capacity: VAV boxes shall be the size, capacity, and airflow range listed on the VAV Box Schedule. VAV boxes with hot water or electric reheat coils shall meet the heating capacity, flowrates, KW, pressure drop, voltage, etc., as listed on the VAV Box Schedule.
- B. Casing: VAV box casing shall be minimum 22 gage galvanized steel, internally lined with polymer foam insulation meeting NFPA 90A (fiberglass insulation not approved). Discharge flange shall be slip and drive construction for attachment to metal ductwork.
- C. Damper: VAV damper shall be heavy gage steel, steel shaft; self-lubricating bearings (nylon bearings are not approved). Shaft shall be permanently marked to indicate damper position,

sealed to prevent over-stroke.

- D. Actuator: Actuators shall provide not less than 35 inch-pounds of torque to the damper shaft.
- E. Hot Water Reheat Coils: Coils shall be comprised of copper tubes, enclosed in 22 gage galvanized casing with slip and drive duct connection. The number of coils, coil capacity, and flowrate shall meet those listed on the VAV Box Schedule.
- F. Electric Reheat Coils: Electric coils shall be ETL and UL listed. Elements shall be 80/20 nickel chrome, supported by ceramic isolators, house by a NEMA 1 enclosure. Coils shall include a primary auto-reset safety thermal cut-out, secondary manual-reset thermal cut-out, and airflow proof switch. Coils shall match the voltage and capacity listed on the VAV Box Schedule.

2.6 ELECTRIC DUCT HEATERS

General: Standard, finned-tubular, slip-in electric duct heater.

- A. Capacity: Electric duct heaters shall be the dimension and heating capacity as listed on the Electric Duct Heater Schedule. Electric shall meet the heating capacity, flowrates, KW, pressure drop, voltage, etc., as listed on the Electric Duct Heater Schedule.
- B. Element: 80% Nickel, 20% chromium finned-tubular element.
- C. Frame: heavy gage corrosion resistant steel.
- D. Controls: Duct thermostat: liquid-filled sensing with snap-acting contacts. -30F – 100F, See plans for required voltage.
- E. Voltage: As Scheduled.

3.0 EXECUTION

3.1 DELIVERY

- A. Delivery from factory to site.
- B. Store, if needed, in safe, dry, location approved by the General Contractor.
- C. Do not use boxed units for construction table.

3.2 INSTALLATION

- A. Complete installation and maintenance instructions shall be furnished as part of shop drawing submittal.
- B. Install units as indicated, and in accordance with manufacturer's installation instructions.
- C. Locate as indicated, level and shim units, anchor to substrate.
- D. Install piping, wiring, and controls per Drawings Details and manufacturer specifications.
- E. Vent gas-fired unit heaters in strict accordance with the International Fuel Gas Code, and manufacturer installation instructions. Vent up through roof through Pate curb and terminate

exhaust and combustion air venting with accessory factory manufactured concentric vent kits.

F. Protect units with protective covers during balance of construction.

3.03 ADJUSTMENT AND CLEANING OF TERMINAL UNITS

A. After construction is completed, including painting, clean all exposed surfaces, and the inside of unit cabinets free of fingerprints, dirt, grease etc.

B. Touch-up any marred or scratched surfaces of factory-finished cabinets, using paint and finish materials furnished by manufacturer.

C. Install second set of filters.

3.04 WARRANTY

A. Standard, minimum, one-year manufacturer's warranty on all parts.

B. One year installing contractor's warranty on installation.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 GENERAL

- A. The scope of work of this section is the furnishing and installing of all air inlet and outlets including:
1. Diffusers
 2. Registers
 3. Grilles
 4. Gravity Relief Hoods
 5. Louvers

1.2 QUALITY ASSURANCE

- A. ADC Compliance: Test and rate registers, grilles, and diffusers in accordance with ADC Equipment Test Code 1062, provide Certified Ratings Seal on each unit.
- B. AMCA Compliance: Test and rate louvers, dampers, and shutters in accordance with AMCA Standard 500, provide Certified Ratings Seal on each unit.
- C. NFPA Compliance: Construct and install air outlets and inlets in accordance with NFPA 90A, and 90B.
1. Comply with NFPA 91 "Standard for Installation of Blower and Exhaust Systems".
- D. Submittals: Submit manufacturer's technical product data, assembly-type shop drawings.

PART 2 PRODUCTS

- A. The diffusers, registers, grilles, and louvers shall meet those specified on the mechanical Grille, Register, and Diffuser (GRD) Schedule including:
1. Dimensional sizes and air connection and neck sizes.
 2. The architectural style shall be matched exactly unless approved by engineer.
 3. Performance including airflow rates, velocities, and noise levels.
 4. Color
 5. Material type
 6. Installation frame including wall mount, floor mount, ceiling mount, soffitt mount, lay-in ceiling mount.
 7. Dampers: where neck dampers are scheduled to be included with the diffuser, register, or grille, provide opposed blade damper for all square and rectangular units, and butterfly dampers on all round units. In general neck dampers shall only be used where branch dampers are inaccessible above hard ceilings.
 8. (Only if applicable to project) Special Requirements (for secured areas only if applicable): Where noted on plans and GRD Schedule provide Minimum- Security, Medium-Security, and Maximum-Security grilles. Grilles shall meet security and suicide prevention level as the scheduled model number requires. Security grilles shall include the following accessories:

- a. Grilles shall be 10 gage steel, powder-coated white paint.
- b. Supply grilles shall be square, 4-way throw, of the dimension scheduled.
- c. Return grilles shall be 10 gage steel mesh, with 10 gage frame..
- d. Grilles shall be fastened to adjacent structure using pin-Torx security fasteners.
Grilles shall be fastened through the flange-frame to steel ceiling or wall framing.
Grilles do not need to be welded to structural steel members.
- e. Where noted on plans provide steel wall sleeves. See schedule for length. Sleeves steel gage shall match the grille gage. The Sheet Metal Contractor may verify required length of sleeve / security bar assembly, and chose the most effective length for installation.
- f. Where noted on plans 3/4" steel security bars, 6" on-center vertical and horizontal fully welded to 6" nominal 10 gage flange-frame.
- g. Stand-alone, in-duct, 3/4" steel security bars welded to slip-in, 10-gage duct-mount frame shall be installed where shown on plans, and as scheduled. Fasten bar assembly through exterior of ductwork, per manufacturer installation instructions.

B. Roof Hoods:

- 1. Manufacturers
 - a. Cook: www.lorencook.com.
 - b. Greenheck: www.greenheck.com.
- 2. Fabricate of aluminum, minimum 16 gage base and 18 gage hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake. Provide mill finish unless indicated otherwise on drawing.
- 3. Provide factory curbs, minimum 16" height unless indicated otherwise on drawings.
- 4. Provide custom finishes and materials where indicated on drawings.
- 5. Sizes shall be as indicated on the Roof Hood Schedule.

2.01 MANUFACTURERS

A. Diffusers, Registers, Grilles:

- 1. Titus
- 2. Price
- 3. Krueger

B. Louvers:

- 1. Greenheck, NCA, Ruskin

All others by approved alternate. Contact engineer for approval.

PART 3 EXECUTION

- A. Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans" and "Interior Elevations". Unless otherwise indicated, locate units

in center of acoustical ceiling modules.

- D. Additional ceiling tees or angles are required to hold ceiling pads because of air inlets or outlets and not shown as part of ceiling work are to be furnished and installed under this section.

END OF SECTION

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONING UNITS

1.1 GENERAL-

- A. This Section includes single and multi-zone ductless split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For split-system air-conditioning units to include in operation and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings" and/or Federal DOE standards.
- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings" and/or Federal DOE standards.

1.4 COORDINATION

- A. Coordinate location and methods of installation for indoor evaporators and outdoor heat-pump/condensing units. Provide condensing unit pad for ground or roof installation, or concrete housekeeping pad for ground installation.
- B. Coordinate roof penetrations and Pate Curbs, or Pate Boots, or wall penetrations where needed for refrigerant line- sets and electrical wiring.
- C. Coordinate thermostat and electrical box location with electrical contractor.
- D. Coordinate sanitary condensate piping with plumbing contractor. If a condensate pump is needed, coordinate mounting with general trades, and wiring and receptacle placement with electrical contractor.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years for compressor and refrigerant circuit, and one year from date of substantial completion for other components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Split-System Ductless Air-Conditioning Units:
 - a. Mitsubishi M-Series
 - b. Fujitsu Halcyon
 - c. LG Art Cool

2.2 MANUFACTURED UNITS

- A. Ductless Split System Air Conditioner (Single Zone):
 - 1. Complete packaged air conditioning unit factory fabricated and tested.

2. Indoor evaporator section: Complete with fan section, motor, washable filter, condensate drain pan for use with gravity drain sanitary piping or field installed condensate pump, and evaporator section.
3. Air cooled heat pump / condensing section: Completely factory piped for single point connection of refrigerant lines. Condensing unit with propeller fan shall be matched to evaporator section to provide cooling capacity as scheduled on drawings.
4. Controls: Unit furnished with factory installed microprocessor controls. Provide hard-wired wall thermostat, which shall provide selection of all functions and control of room temperature set points. Furnish and install one mounting bracket for each wireless remote control.
5. Provide complete refrigerant piping circuit (including all piping specialties) sized in accordance with manufacturer's requirements to interconnect evaporator and condenser sections.

B. Ductless Split System Air Conditioner (Single or Multi Zone):

1. Complete packaged air conditioning unit factory fabricated and tested.
2. Indoor evaporator sections: Complete with fan section, motor, washable filter, condensate drain pan designed for gravity drain sanitary piping or field installed condensate pump, and direct expansion evaporator section.
3. Air cooled condensing section: Completely factory piped for single point connection of refrigerant lines serving one, two, three or four remote evaporator sections. Condensing unit with propeller fan shall be matched to combined evaporator sections to provide cooling capacities as scheduled on drawings.
4. Controls: Unit furnished with factory installed microprocessor controls. Provide hard-wired wall thermostat under tamper-proof thermostat box for each evaporator section which shall provide selection of all functions and control of room temperature set points. Furnish and install one mounting bracket for each remote control.
5. Include Bacnet interface board controller with each unit.
6. Provide complete refrigerant piping circuits (including all piping specialties) sized in accordance with manufacturer's requirements to interconnect evaporator and condenser sections.

2.3 EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel chassis with removable panels on front and ends, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, with thermal-expansion device.

- C. Fan: Direct drive, ultra-quiet centrifugal fan, and integral factory or field installed condensate pump.
- D. Fan Motors: Comply with requirements.
 - 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- E. Filters: Permanent, cleanable.

2.4 AIR-COOLED, CONDENSER-COMPRESSOR COMPONENTS

- A. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Variable-speed, inverter drive digital scroll, with low ambient cooling capable of providing 100% capacity down to -20F.
- C. Not applicable to this project: Heat Pump Components: Reversing valve and low-temperature. Heat pump thermostat with adjustable, programmable, heat pump cut-out temperature adjustment.
- D. Fan: Aluminum-propeller type directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.

2.5 ACCESSORIES

- A. Thermostat: Hard-wired, wall-mounted low voltage type to control compressor and evaporator fan. Include tamper-proof thermostat cover.
 - 1. Liquid-crystal display indicating temperature, set-point temperature, operating mode, and fan speed.
 - 2. Fan-speed selection.
 - 3. Not applicable to this project: Heat Pump Cut-Out Temperature
 - 4. 7-day scheduling programmability.
 - 5. Exterior (or interior) wall mount kit (provide as Scheduled).
 - 6. **Not Applicable to this Project:** Bacnet interface board (integration to the TCS)

- B. Automatic-reset timer to prevent rapid/short cycling of compressor.
- C. Low-ambient cooling kit.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, and sealed; factory-insulated suction line.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units' level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted compressor-condenser components on condensing unit pad with wind bracing anchors and support.
- D. Install and connect refrigerant tubing to components. Install tubing to allow access to unit. Evacuate and charge with refrigerant in strict accordance with manufacturers instructions.

3.2 CONNECTIONS

- A. Install piping adjacent to unit to allow service and maintenance.
- B. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in accordance with manufacturers' instructions.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 01

SELECTIVE ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SCOPE

- A. Work Included: Selective electrical demolition for remodeling.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with Utility Company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Construction Manager at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work as indicated on Drawings.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply. This includes but is not limited to power conductors, fire alarm cables, intercom cables, voice cables, data cables, coaxial cable, and control wiring unless noted otherwise.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces to match existing adjacent finishes.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlet boxes if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes and flush junction boxes that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work to match existing.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods as specified.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.5 INSTALLATION

- A. Install relocated materials and equipment as indicated in other specification Sections and on the Drawings.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section encompasses the selection and installation of low-voltage (600V and less) electrical power conductors and cables for all types of applications.

1.2 SUBMITTALS

- A. Provide certified test reports from the cable manufacturer.

1.3 DELIVERY AND STORAGE

- A. Provide cable on original reels or in boxes, new and unused.
- B. Store cables in dry protected area and protect cable ends in accordance with manufacturers recommendations.

1.4 REFERENCES

- A. Fed. Spec. J-C-30A(1): Cable and Wire Electrical (Power, Fixed Installation)
- B. UL No. 44: Rubber-Insulated Wire and Cables
- C. UL No. 83: Thermoplastic-Insulated Wires
- D. UL No. 493: Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

1.5 RELATED DOCUMENTS

- A. Section 26 05 13: Medium Voltage Cables
- B. Section 26 05 26: Grounding and Bonding for Electrical Systems
- C. Section 26 05 29: Hangers and Supports for Electrical Systems
- D. Section 26 05 53: Identification for Electrical Systems
- E. Section 26 05 83: Equipment Wiring Connections
- F. Section 26 27 26: Wiring Devices

PART 2 PRODUCTS

2.1 LOW-VOLTAGE LIGHTING AND POWER CONDUCTORS

- A. Conductors provided on 600 volt power and lighting systems to be solid soft drawn copper or stranded soft drawn copper per ASTM B-8 for wires sizes #8 AWG through #14 AWG and stranded soft drawn copper per ASTM B-8 and ICEA 61-402 for #6 AWG wire sizes and larger.
- B. Insulation system shall be type THHN, THWN, or XHHW rated 600V as defined and listed in Article 310 of NEC.
- C. Minimum size conductor utilized shall be #14 AWG for lighting circuits and #12 AWG for power circuits.
- D. Each power cable color shall be coded by manufacturer.
- E. Acceptable manufacturers are Aetna Industrial Wire, American Insulated Wire, Cerro Wire, Encore Wire, Southwire, United Copper Industries, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Low-Voltage Lighting and Power Conductors:
 - 1. Install only after completion of work that might cause damage to wires or conduit.
 - 2. Clean out or replace conduit in which dirt, water, concrete, or other foreign matter has been allowed to accumulate, before installing wiring.
 - 3. Identification of insulated conductors: mark on outer cover giving voltage, type, and size. In addition, identify each end of each conductor wire with marking tape or sleeve.
 - 4. Splices:
 - a. No wire splices allowed in entire length of conduit or raceway.
 - b. Make splices in electrical enclosures.
 - c. Splice insulation: Equal to original factory insulation.
 - d. Splicing copper to aluminum: Use aluminum-copper connections; approved as suitable for the purpose.
 - 5. Termination of Conductors:
 - a. Insulated type compression lugs, “Sta-Kon” type by Thomas & Betts, or equal.
 - b. At distribution equipment containing aluminum bus bars; use aluminum copper lugs rated and approved for the application.
 - c. For lighting and receptacle circuits: “Scotchlox Spring” connectors manufactured by 3M Company, or equal.
 - 6. Common/shared neutrals are not acceptable. Provide one neutral conductor per each individual branch circuit and/or feeder.

- B. Instrumentation Cable:
1. Install only after completion of work that might cause damage to wires or conduit.
 2. Clean out or replace conduit in which dirt, water, concrete, or other foreign matter has been allowed to accumulate, before installing wiring.
 3. Splices: No wire splices allowed in entire length of conduit or raceway.
 4. Provide separate conduit for instrumentation circuits.
 5. Mark on outer cover the service loop number at each end and each conductor the wire number by wire marking type or sleeve.
- C. Lace or clip groups of feeder conductors at distribution centers, pullboxes, and wireways.
- D. Use Listed wire-pulling lubricant for Pulling No. 4 AWG and larger wire. Do not pull cables through conduit with more than allowable bends specified in NEC Table 344.24.
- E. Limit the number of conductors in boxes so that the maximum number does not exceed the number permitted by Tables 314.16(A) & (B) of the National Electrical Code.
- F. Support conductors in vertical raceways in accordance with the National Electrical Code.
- G. Cable supports shall be O-Z/Gedney Type "R".
- H. Wiring for emergency systems shall be installed in separate conduit runs.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers the selection and installation of the equipment for effective grounding and bonding of structures and electrical systems.

1.2 SUBMITTALS

- A. Certified test reports on cable and ground rods.
- B. Ground resistance tests.

1.3 REFERENCES

- A. IEEE Standard 142-1972, Grounding
- B. NFPA 70, National Electrical Code, Article 250
- C. ANSI/NEMA GR-1
- D. ANSI/UL 467
- E. NECA 331-2009, Standard for Building and Service Entrance Grounding and Bonding

PART 2 PRODUCTS

2.1 GROUND RODS

- A. ~~---BUILDINGS WITH STEEL STRUCTURE---~~Ground rods for grounding the building structure shall be 3/4" dia. x 5'-0" long, steel welded to the reinforcing bars in the concrete.

2.2 GROUND CONNECTIONS

- A. Shall be thermally welded/fused where concealed. Acceptable manufacturers are:
 - 1. Continental Industries Thermoweld
 - 2. Erico Cadweld
 - 3. Harger Lightning & Grounding Ultraweld
 - 4. Hubbell BurndyWeld
 - 5. Thomas & Betts Blackburn
 - 6. Approved equal
- B. Shall be mechanical where exposed to view.

2.3 GROUNDING ELECTRODE CONDUCTOR

- A. Grounding electrode shall be soft drawn copper sized in accordance with Table 250.66 of N.E.C., stranded except solid where penetrating concrete surface.
- B. Where the grounding conductor penetrates a concrete surface use a 3/4" dia solid copperbonded rod or a thermoweld anti-syphon water stop.

PART 3 EXECUTION

3.1 GROUNDING ELECTRODE SYSTEM

- A. ~~---BUILDINGS WITH STEEL STRUCTURE---~~All structural steel shall be securely grounded to ground rods in the footings. All connections shall be welded.
- B. ~~---BUILDINGS WITH STEEL STRUCTURE---~~All structural steel shall be securely bonded together. Electrical Contractor shall ensure that all structural steel is effectively grounded.
- C. ~~---BUILDINGS WITH STEEL STRUCTURE---~~Main service panel and separately-derived sources shall be securely bonded to the building structure.
- D. Ground Rod Installation: Drive each rod vertically for not less than ten feet. Multiple rods: Where required to obtain the specified ground resistance, install multiple rods. Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.
- E. Service entrance ground conductor shall be connected to the building water service. Where ground connection is made to the water service on the building side on the water meter, a jumper or shunt shall be installed around the water meter, the current carrying capacity and mechanical protection shall not be less than required for the grounding conductor. Ends of the grounding electrode conductor shall be tinned.
- F. Test ground resistance with a ground meter of bridge type and report results to Architect/Engineer. Drive additional rods as directed by Architect/Engineer. Additional rods will be paid for as an extra. The system resistance should not exceed 5 ohms.

3.2 GENERAL

- A. Ground all metallic conduits, supports, cabinets and equipment in accordance with the National Electrical Code. Ground wire shall be of the same kind and quality as other conductors in the building, shall be placed in steel conduit runs as specified for branch circuits, and shall be sized to meet the requirements of the National Electrical Code.
- B. Grounding conductors shall be attached to equipment by means of approved copper alloy solderless grounding lugs or clamps which shall be attached to the equipment and the grounding point by means of hexhead cap screws or machine bolts after the contact surfaces have been cleaned to bright metal.

- C. Ground conductors run in conduit with circuit conductors shall be securely connected inside the junction boxes or enclosures. Ground conductors terminating at the motor control centers, switchgear, shall be terminated at the ground bus.
- D. Splices in ground conductors shall be made using the thermal weld/fusion process.
- E. Ground straps shall be supported at intervals not exceeding two (2) feet by means of round head bronze machine screws and approved type anchors.
- F. Flexible or nonmetallic conduit will not be approved for continuity in a grounding system. A separate ground wire shall be installed and bonded to conduit system on both sides of flexible conduit. A separate ground wire shall be installed in all non-metallic conduit. Ground motor bases and frames pulling a separate conductor in with the motor feeder.
- G. Install a bonding jumper around expansion fittings to maintain continuous ground continuity.
- H. All power feeds to panels, motors, etc. shall contain a ground conductor sized according to the N.E.C. The conduit system shall not be considered an acceptable ground.
- I. All branch feeds to lights, receptacles, equipment, and general distribution shall contain a ground conductor sized according to the N.E.C. The conduit system shall not be considered an acceptable ground.
- J. Indicated circuits shall be provided with isolated grounding as per N.E.C. rules. Size conduits appropriately for feeds as isolated ground circuits require both the isolated (signal ground) conductor and the equipment grounding (safety) conductor.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 REFERENCE STANDARDS

- A. NECA 1: Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- B. NFPA 70: National Electrical Code; National Fire Protection Association; 2008.
- C. ASTM A123: Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
- D. ASTM A653: General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process
- E. ASTM A1011: Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability (Formerly ASTM A570)
- F. ASTM F1136: Standard Specification for Chromium/Zinc Corrosion Protective Coatings for Fasteners
- G. ASTM A907: Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, Structural Quality
- H. ASTM B633: Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- I. MFMA: Metal Framing Manufacturers Association
- J. MSS SP-69: Manufacturers Standardization Society - Pipe Hangers and Supports - Selection and Application.
- K. ANSI/NFPA 70: National Fire Protection Association (National Electrical Code)
- L. AISI: American Iron and Steel Institute

1.3 SUBMITTALS

- A. See Division 1 and Section 26 05 00 for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.5 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.
- 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners – General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Supports: Fabricated of structural steel or formed steel members; galvanized.
- C. Anchors and Fasteners:
 - 1. Do not use powder-actuated anchors, spring clips, or beam clamps.
 - 2. Obtain permission from Architect/Engineer before using powder-actuated anchors.
 - 3. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
 - 4. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
 - 5. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
 - 6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
 - 7. Solid Masonry Walls: Use expansion anchors or preset inserts.
 - 8. Sheet Metal: Use sheet metal screws.
 - 9. Wood Elements: Use wood screws.
- D. Channel Support Systems

1. U-Channels: Roll formed from 12-gauge steel. U-Channel width 1-5/8", height shall be sized for the application of the channel and the device it supports.
 - a. Channel for indoor, dry application shall have one of the following finishes.
 - 1) Pre-Galvanized Zinc Coating – ASTM A525 G-90
 - 2) Finish equal to B-Line Dura-Green®™ or Unistrut Perma-Green®™
 - b. Channel for outdoor, wet and damp application shall have Hot-Dipped Galvanized After Fabrication - ASTM A123 finish.
2. Fittings and accessories:
 - a. Fittings and accessories shall be manufactured by the U-Channel manufacturer.
 - b. Indoor, dry application finish: Electro-plated Zinc – ASTM B633.
 - c. Outdoor, wet, and damp application finish: Hot-Dipped Galvanized After Fabrication - ASTM A123.
- E. Conduit clamps, straps, supports, etc., shall be steel or malleable iron.
- F. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.
- G. Fastening Hardware including screw, bolts, nuts, washers, etc. shall be stainless steel in outdoor, wet or damp locations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 2. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- C. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.
- E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

- F. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.
- G. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

END OF SECTION

SECTION 26 05 34

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. All conduit work associated with the electrical and control work.
 - 1. All inside installation of conduit runs between switchgear, motor control centers, control stations, power panels, transformers, light fixtures, switches, instruments, and motors.
 - 2. All outside installation of conduit runs to all exterior components.
 - 3. All underground conduit runs throughout the site.
 - 4. All embedded conduit runs.

1.2 RELATED DOCUMENTS

- A. Section 03 30 00: Cast-in-Place Concrete
- B. Section 26 05 29: Hangers and Supports for Electrical Systems
- C. Section 26 05 83: Equipment Wiring Connections

1.3 REFERENCES

- A. Fed. Spec. W-C-582(1), Conduit, Raceway, Metal, and Fittings; Surface
- B. Fed. Spec. W-C-1094A, Conduit and Conduit Fittings Plastic, Rigid
- C. Fed. Spec. W-F-406B, Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible
- D. Fed. Spec. W-F-408C(1), Fittings for Conduit, Metal, Rigid (Thick-wall and Thin-wall (EMT) Type)
- E. UL No. 1, Flexible Metal Electrical Conduit
- F. UL No. 5, Surface Metal Electrical Raceway and Fittings
- G. UL No. 651, Rigid Non-metallic Electrical Conduit
- H. UL No. 797, Electrical Metallic Tubing
- I. ANSI C.80.1, Rigid Metal Conduit
- J. ANSI C.80.3, Electrical Metallic Tubing

PART 2 - PRODUCTS

2.1 CONDUIT

- A. All conduit shall be Listed in accordance with applicable standards.
- B. Rigid metallic conduit (RMC) shall be hot-dipped galvanized, threaded, and be manufactured in accordance with ANSI Specification C80.1.
- C. PVC-coated galvanized steel conduit shall conform to NEMA RN-1-1974 (Type A-40).
- D. Intermediate metal conduit (IMC) shall be galvanized, threaded, and be manufactured in accordance with Article 342 of the NEC. Minimum ½” trade size.
- E. Rigid nonmetallic conduit (RNC) shall meet the requirements of NEC Article 352. Rigid nonmetallic conduit shall be Schedule 40, rigid heavy-wall polyvinyl chloride (PVC), 90°C rated. Connectors and couplings shall be solvent weld type. Conduit shall comply with ASTM D1785- 76, Schedule 40 to comply with ASTM F512.79.
- F. Electrical metallic tubing (EMT) shall be manufactured in accordance with ANSI Standards, Specification C80.3. Connectors and couplings to be steel set screw type for all sizes.
- G. Liquid-tight flexible metallic conduit (LFMC) shall be steel armor flexible plastic jacketed type with liquid-tight connectors. Conduit shall be high-grade, interlocking, spiral strip steel with oil- resistant, sunlight-resistant, waterproof PVC jacket as manufactured by American Brass Co., Triangle Conduit and Cable Co., Anaconda “Sealtite” or equal.
- H. Flexible metallic conduit (FMC) shall be ½” minimum trade size (3/8” not exceeding 6’ for light fixtures only). Connectors to be malleable iron threaded type.
- I. Conduit fittings including couplings, nipples, elbows, and conduit bodies shall be Listed for the application and conform to JIC standards. Fittings shall be malleable iron cadmium plated, steel, or aluminum alloy. All conduit bodies needed for communications cabling shall be by Smart Conduit Bodies or equal conforming to 1” minimum bend radius.
- J. In explosive areas, conduit, junction boxes, and seals shall be Class 1, Division 1, Group D.
- K. Acceptable manufacturers of conduit are: Allied, Carlon, O-Z/Gedney, Republic, Wheatland, or equal.

2.2 UNDERGROUND DUCTBANKS

- A. Conduit Size: As called out in schedule.
- B. Material: Schedule 40 heavy wall rigid polyvinyl chloride or rigid galvanized heavy wall steel, marked at uniform intervals to indicate the kind of material.
- C. The ducts shall be as manufactured by Orangeburg, Bermico Co., Carlon, or equal. Provide concrete hand holes with cast iron covers when required by code or drawings.
- D. Elbows: Rigid heavy wall galvanized steel with a minimum bend radius of 36 inches (915 mm).

- E. Spacers: Plastic, to maintain 4" between conduits.
- F. Bell Ends: Manufactured bell ends of appropriate sizes at each end of conduit.
- G. Bushings: Premanufactured fiber or groundable steel bushings of appropriate sizes where bell ends are not used. Steel bushings shall be used on all metal conduits.
- H. Plugs: Closure plugs or caps of same material as conduit at ends of unused sections.
- I. Tie Wire: Nonferrous, to prevent displacement of the ducts and conduits during pouring of concrete. Do not use tie wires as substitutes for the spacers.
- J. Pull Wire: 1/8" nylon pull rope in each empty duct.
- K. Grounding: Steel grounding bushings shall be grounded to manhole or junction box ground. On steel conduit with end bells, provide an Appleton Catalog No. XJB series or equal bonding fitting with bonding strap.
- L. Connect bonding strap to ground wire in manhole or junction box.
- M. Drainage Assembly: All ducts shall drain to an open end - preferably a manhole.
- N. Concrete Encasement: Concrete shall be as specified in Section 03 30 00.
- O. Encase duct with 3 in. minimum of concrete on top, bottom, and sides with top of duct crowned to prevent puddling of water.
- P. Reinforcing Steel: Provide reinforcing steel at road crossings and parking lots. Extend rebar 5' past pavement.

2.3 MANHOLES

- A. Constructed of precast concrete.
- B. Round type shall be 6 feet in internal diameter, square type 5 foot square. Manhole shall be at least 6 foot deep with 6 inch grade ring on entrance hole.
- C. Entrance hole shall be at least 2 feet in diameter with the frames and covers being Neenah Series R 1975, East Jordan Iron Works, Inc., Series 1220, or equal with the word "Electrical" cast in the cover in 2 inch raised letters.
- D. All casings shall be coated with coal-tar pitch varnish, with sufficient oil added to produce a smooth tough coating, tenacious when cold, and not brittle nor with any tendency to scale off.
- E. Provide cast in place inserts for bolting cable racks and 1 inch diameter galvanized steel pulling irons, 12 inches long with twin nuts and backing plate.
- F. Provide reinforced plastic steps on 16-inch centers cast into the side wall.
- G. Manufacturers shall be Advance Concrete, Hartford Concrete, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the conduit in accordance with the manufacturer's recommendations.
- B. All buried conduit within 5'-0" of the building, under roadways and locations marked on the drawings shall be encased with a minimum of 3" of concrete.
- C. Paint the ends of the conduit jointing couplings or threaded fittings with zinc rich coating of at least 90% purity zinc.
- D. Coat all metallic conduits in contact with the earth with two heavy coats of asphaltum paint. Coat new threads with one coat as asphaltum paint, wrap with cloth and finish with a heavy coating of asphaltum paint applied over the entire joint.
- E. In rooms and areas having a corrosive atmosphere, use only PVC coated conduit and enclosures for electrical devices. Solid PVC conduit allowed only where specifically noted or with written permission of the Engineer. In these areas, conduit and enclosures shall be gas-tight using seal-off fittings where conduit enters or leaves such areas.
- F. Install concealed conduits in as direct a line and with as long bends as possible. Install exposed conduits parallel to or at right angles with the lines of the building. Route conduit for lighting system between fixtures and from fixtures to switches so that no supply wires are installed in switch legs. Do not install conduit under water heaters, boilers and furnaces. Make bends with standard conduit ells or field bend conduit in accordance with N.E.C. Tables 344-24. All bends shall be free from dents or flattening. Do not use more than the equivalent of four ninety-degree bends in any run between terminals at cabinets, outlets, and junction or pull boxes. Conduit should enter through only bottom of boxes unless otherwise specified.
- G. Conduits shall be continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes, and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets. Terminate all conduits with two locknuts and bushings. Joints shall be cut square, reamed smooth, and drawn up tight. All conduits not terminated in metal fittings or metal cabinets and secured with locknuts shall be terminated with grounding bushings.
- H. Plug the ends of each conduit with an approved cap or disc to prevent the entrance of foreign material when exposed during construction. Conduit systems shall be completed and the building shall be enclosed before conductors are installed.
- I. Electrical work shall not impair the structural strength of the building. Do not install an excessive amount of conduit in structural members, place sleeves at stress points, etc. American Concrete Institute Standard 318.71, Paragraph 6.3, shall govern placement of conduit in concrete construction.
- J. Install expansion fittings in all conduit runs crossing an expansion joint with an external bonding jumper.
- K. Conduit terminating at equipment mounted on vibration isolators (such as air handling units and compressors) shall be provided with flexible conduit before being terminated.

- L. Furnish and install seal-off fittings in all conduit runs exposed to different temperatures. Install fittings in accessible locations to permit periodic inspection.
- M. Make conduit mechanically tight and electrically continuous throughout. Conduit system shall be grounded at service entrance.
- N. Flexible metallic conduit (FMC) shall be used for connections from outlet boxes or conduit stubs, to motor junction boxes for motors installed in dry locations, and connections to control devices such as solenoid valves and pressure electric switches in dry locations.
- O. Liquid tight flexible metallic conduit (LFMC), Anaconda “Sealtite” or equal, shall be used for connections of motors 1/2 hp or larger, motors in wet locations, and roof mounted motors.
- P. Adjustable hangers may be used to suspend 3-inch or larger conduits when separately located. If adjustable trapeze hangers are used to support groups of parallel conduit, U-bolts or similar type clamps shall be used at the end of the conduit run and at each elbow. J-bolts or approved clamps shall be installed on each third intermediate trapeze hanger to fasten each conduit.
- Q. Conduit shall not be run on or supported from mechanical equipment.
- R. Raceway Type Application:
 - 1. Service Entrance:
 - a. RNC in or below slabs and underground
 - b. RMC above grade or slab, or exposed
 - 2. Feeders, Branch Circuits, and Systems Conduit:
 - a. Underground and in or below concrete slabs – RNC (PVC) with bare ground wire. RMC when below hazardous location.
 - b. Above slab or grade:
 - 1) Exposed interior spaces below 8’-0” AFF – EMT
 - 2) Exposed interior spaces below 8’-0” AFF where subject to mechanical damage –
 - 3) RMC or IMC
 - 4) Exposed interior spaces above 8’-0” AFF – EMT
 - 5) Concealed in walls and above ceilings – EMT
 - c. Exposed in wet or damp locations, on building exteriors, roofs, or site – RMC or IMC (or PVC when not subject to mechanical damage)
- 3.2 Return air plenums – Use only metallic conduit or approved cable in return air plenums in accordance with NEC Article 300.22.

A. UNDERGROUND INSTALLATION

- B. This Contractor shall furnish and install underground conduits as indicated on the Drawings, including all excavating, pumping, backfilling, shoring, and removal of surplus earth.
- C. Contractor shall locate all underground obstructions that may interfere with his work. This Contractor shall be held responsible for any damage he may inflict on other underground systems and shall assume all cost of repairing the same.
- D. Excavations: Excavate trenches for ductbank to adequate width, depth, and proper slope. Install forms on sides of ductbank if trench is not of proper firmness to prevent cave-in. Bottom of trench shall be undisturbed earth. If trench bottom is too low for proper grade, fill to proper level with sand and mechanically compact it. Each excavated section from manhole to manhole and from manhole to building shall be completely excavated and graded before any duct is laid in that section.
- E. Placement of Conduit: Within five (5) feet of each building, box pad, concrete pad, or manhole wall penetration install heavy wall galvanized steel conduit within the concrete envelope to provide protection against vertical shearing.
- F. Core drill all existing walls, footings and manholes and waterproof after the new conduit is installed.
- G. Install spacers as recommended by conduit manufacturer and requirements stated above, but not to exceed a maximum of 6 ft-0 in. on center for PVC conduit and 8 ft-0in. on center for steel conduit. Bottom spacers shall rest on 8" X 16" X 2" minimum concrete pads to prevent them from sinking into the ground and reducing the bottom concrete cover.
- H. Pitch conduit properly for drainage to manhole or pull box and to prevent low pockets or irregular dips between conduit ends. Minimum pitch shall be 4 in. per 100 ft.
- I. In ductbanks with both primary and signal conduit, primary conduit shall be straight and the signal conduit shall contain bends as necessary to accommodate the primary duct. Any offsets or bends shall be made in steel conduit. PVC conduit may only be used in straight lengths.
- J. Install flush bell ends on duct at manholes. Install insulated, grounding bushings on duct ends in equipment enclosure.
- K. Pull mandrels and swabs (diameter ¼ in. smaller than conduit) through each conduit in completed ductbank before installing cables.
- L. Backfill: Install underground warning tape 12" below finish grade over all ductbanks. . The marker shall be yellow, 6" wide, and labeled "BURIED ELECTRIC LINE" or similar and shall have an aluminum center core for future detection. Compact backfill around ductbanks. Restore areas to original conditions or as indicated on drawings after installation of ductbanks.

END OF SECTION

SECTION 26 05 37

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

- A. The work includes all junction boxes and pull boxes for all interior, exterior and hazardous locations.
- B. The work includes all outlet boxes for all interior, exterior and hazardous locations.
- C. Selection and installation of electrical, communications, instrumentation, cabinets and enclosures suitable for interior, exterior, hazardous location use.

1.2 RELATED DOCUMENTS

- A. Section 26 05 34: Conduit for Electrical Systems

1.3 REFERENCE STANDARDS

- A. NEMA ICS 6, Enclosures for Industrial Control and Systems
- B. UL No. 50, Cabinets and Boxes
- C. NFPA 70, National Electrical Code

1.4 SUBMITTALS

- A. Shop drawings and product data for floor boxes and underground junction boxes. Indicate large-scale details, construction conditions, plug layout, joints, accessories, dimensions and finishes.

PART 2 PRODUCTS

2.1 GENERAL PURPOSE BOXES

- A. Pullboxes and junction boxes to be hot dipped galvanized steel with screw-on covers.
 - 1. Provide boxes with enameled finish.
 - 2. Boxes shall be Listed, NEMA Type 1 for interior locations and Type 3R for exterior locations, unless otherwise noted or required, and shall conform to JIC standards.
 - 3. Flush mounted pullboxes shall be provided with overlapping covers, flush head cover and plated retaining screws prime coated.

- B. Outlet boxes to be hot dipped galvanized steel with screw-on covers.
 - 1. Boxes shall conform to JIC standards
- C. Fabricated pullboxes and splice cabinets to be constructed from Code gauge, sheet steel, galvanized after fabrication with full-access screw covers mounted with corrosion-resistant machine screws. Covers shall be for flush installation where noted. Box size shall be as required by the N.E.C. for the number of conduits and conductors entering and leaving it. Where intermediate cable supports are necessary because of box dimensions, provide insulated, removable cross brackets to support the conductors. Pullboxes shall be enough to provide ample work space for making feeder splices.
- D. Control cabinets and panels shall be of metal construction, prime coated, finish painted and of NEMA Type 1 for interior locations and Type 3R for exterior locations, unless otherwise noted or required.
 - 1. Cabinets and panels shall be equipped with key-locking regular handle.
 - 2. Cabinets and enclosures shall come with backplates.
 - 3. Terminal Strips:
 - a. Applied on systems less than 150 volts shall be screw terminal type.
 - b. Applied on systems greater than 150 volts shall be 600 volt screw terminal type with barriers between each set of terminals and individual terminal points for each conductor.
 - 4. Identify terminal strips with permanent labels.
 - 5. Provide wiring diagram and panel layout drawing on inside of each cabinet door showing circuits and conductors connected to the cabinets.
 - 6. Acceptable manufacturers are Hoffman, Appleton, O-Z/Gedney, or equal.

2.2 UNDERGROUND JUNCTION BOXES

- A. Underground pull boxes and junction boxes to be constructed of precast polymer concrete with bolt-on covers.
 - 1. The precast polymer concrete shall have the minimum material properties:
 - a. Modulus of elasticity: 10^6 psi.
 - b. Compressive strength: 9000 psi
 - c. Flexural strength: 3000 psi
 - d. Impact energy: 30 ft-lbs/sq.in.
 - e. Tensile strength: 800 psi

2. Boxes shall be UL Listed to ANSI/SCTE 77-2007 standards.
3. Boxes shall be 24" wide x 36" long x 30" deep (minimum) unless noted otherwise.
4. Boxes and covers shall be rated for sidewalk applications with a safety factor for non- deliberate vehicular traffic, ANSI Tier 8
5. Covers shall be provided with and secured by a minimum of two stainless steel hold-down bolts.
6. Boxes shall be Quazite PG-series as manufactured by Hubbell Lenoir City, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION – GENERAL

- A. Clean out moisture, dirt, metal filings, and other foreign matter from the interior of boxes.
- B. Assure that all conduit fittings that enter the box are tight and secure.
- C. Support pullboxes independently of conduit entering them. Use brackets, rod hangers, bolt or other suitable supporting methods. Cabinets shall be securely anchored to the concrete base slab or wall.
- D. All holes in cabinets shall have hole seals or louver plates attached.
- E. Assure that doors fit snugly, but do not bind.
- F. Recessed mounted outlet and switch boxes shall be installed with the box face flush to 1/4" maximum recessed in non-combustible walls. Boxes shall be dead flush in combustible walls. Box face shall be parallel to block face, plumb top to bottom, securely fastened in wall with no movement possible.
- G. Install appropriately designed pullboxes where indicated on the Plans, and where necessary to terminate, tap-off or redirect, multiple conduit runs. In general, conduit runs of more than 100 feet, or with more than four right angle bends shall have a pullbox installed at a convenient intermediate location. Locate pullboxes so that covers are accessible after completion of construction.
- H. In hazardous areas, use only explosion-proof boxes.
- I. In rooms and areas having a corrosive atmosphere use only PVC or molded fiberglass boxes.

3.2 INSTALLATION – UNDERGROUND JUNCTION BOXES

- A. Install box per the manufacturer's recommended installation instructions.
- B. Install boxes with a minimum of six inches of gravel or crushed rock underneath for drainage.
- C. Install boxes flush with finished grade.

- D. Enclosure shall be bonded to equipment grounding conductor per NEC requirements.
- E. Seal all conduits entering the boxes vertically from moisture ingress.
- F. Install electrical components in compartments or enclosures that are isolated from communications components.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: All conduit work associated with the plans.

1. All underground conduit runs throughout the site.
2. All embedded conduit runs.

B. Related Sections:

1. Section 31 23 16: Excavating

1.2 SUBMITTALS

A. Product Data, Shop Drawings, Samples: All products shall be submitted for review by Architect.

B. Contract Closeout Submittals: All sleeve locations shall be clearly identified on as-built drawings at the completion of the project.

1.3 QUALITY ASSURANCE

A. Qualifications: Installer shall have satisfactorily installed conduit for a minimum of two (2) years.

B. Regulatory Requirements & References:

1. Federal Specifications (Fed. Spec.):
 - a. W-C-1094A: Conduit and Conduit Fittings Plastic, Rigid
 - b. W-F-406B: Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible
2. Underwriters' Laboratories, Inc. (UL) Publications:
 - a. No. 651: Rigid Non-metallic Electrical Conduit

C. Pre-Installation Conference: A pre-installation conference may be required to coordinate work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Properly ship and pack all materials to prevent damage to product during transport.

B. Acceptance at Site: All products shall be accepted by the Contractor at time of delivery.

C. Storage and Protection: Store and protect product properly to prevent damage.

1.5 PROJECT/SITE CONDITIONS

A. Existing Conditions: Review existing conditions prior to beginning work.

B. Field Measurements:: Field measure existing conditions prior to beginning work.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate all work with job site superintendent and all applicable trades.

1.7 WARRANTY

A. Provide minimum one (1) year warranty against defects for materials and installation, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit:

1. P.V.C.: Rigid nonmetallic conduit shall be U.L. listed in conformity with the requirements of NEC Article 347. Rigid nonmetallic conduit shall be Schedule 40, rigid heavy wall polyvinyl chloride, 90°C. U.L. rated. Connectors and couplings shall be solvent weld type. RNMC shall be manufactured by "Carlton". Conduit shall comply with ASTM D1785-76, Schedule 40 to comply with ASTM F512.79.
2. Conduit fittings including couplings, nipples, elbows and conduit bodies shall be U.L. listed and conform to JIC standards. Fittings shall be malleable iron cadmium plated, steel, or aluminum alloy.
3. Manufacturers shall submit information to Engineer ten (10) days prior to bid date for approval.

B. Underground Raceways:

1. Conduit Size: 4" nominal
2. Material: Schedule 40 heavy wall rigid polyvinyl chloride marked at uniform intervals to indicate the kind of material.
3. The underground/grade splice/pull boxes shall be as manufactured by Electromold, Inc., Carlton, or Quazite. Provide concrete hand holes with cast iron covers when required by code or drawings.
4. Spacers: Plastic, to maintain 4" between conduits.
5. Bell Ends: Manufactured bell ends of appropriate sizes at each end of conduit.

6. Plugs: Closure plugs or caps of same material as conduit at ends of unused sections.
7. Pull Wire: 1/8" nylon pull rope in each empty duct.
8. Concrete Encasement: Concrete shall be as specified in Section 02.620. Encasement is at roadway crossing areas, parking lots, and as per Plans and Specifications.
9. Encase duct with 3 in. minimum of concrete on top, bottom, and sides with top of duct crowned to prevent puddling of water.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify existing conditions and notify Construction Manager of any areas that may affect a quality installation.

3.2 PREPARATION

- A. Protection: Protect all surfaces from damage during installation.

3.3 INSTALLATION

- A. Install the conduit in accordance with the manufacturer's recommendations. Buried conduits outside the building shall be encased with a minimum of 3" of concrete (as required by paragraph 2.2/B./8. above) and locations marked on drawings. For encased in concrete or setting under or in concrete floor, use only galvanized steel or PVC if noted on drawings.
- B. Plug the ends of each conduit with an approved cap or disc to prevent the entrance of foreign material when exposed during construction. Conduit systems shall be completed and the building shall be enclosed before conductors are installed.
- C. This Contractor shall furnish and install underground conduits as indicated on the Drawings, including all excavating, pumping, backfilling, shoring, and removal of surplus earth.
- D. Contractor shall locate all underground obstructions that may interfere with his work. This Contractor shall be held responsible for any damage he may inflict on other underground systems and shall assume all cost of repairing the same.
- E. Excavations: Excavate trenches for ductbank to adequate width, depth, and proper slope. Install forms on sides of ductbank if trench is not of proper firmness to prevent cave-in. Bottom of trench shall be undisturbed earth. If trench bottom is too low for proper grade, fill to proper level with sand and mechanically compact it. Each excavated section from manhole to manhole and from manhole to building shall be completely excavated and graded before any duct is laid in that section.
- F. Pitch conduit properly for drainage to manhole or pull box and to prevent low pockets or irregular dips between conduit ends. Minimum pitch to be 4 in. per 100 ft.

G. Pull mandrels and swabs (diameter ¼ in. smaller than conduit) through each conduit in completed ductbank before installing cables.

H. Backfill: Install underground warning tape 12” below finish grade over all ductbanks. Tape shall be orange with the words “CAUTION-Electric Line Buried Below”. Tape shall be Seton Catalog No. 210 or equal. Compact backfill around ductbanks. Restore areas to original conditions or as indicated on drawings after installation of ductbanks.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

1 GENERAL

1 .1 SECTION INCLUDES

- A. Nameplates and labels
- B. Wire and cable markers

1 .2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008

1 .3 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions for submittals procedures.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1 .4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2 PRODUCTS

2 .1 IDENTIFICATION REQUIREMENTS

- A. Buried Electrical Lines: Underground warning tapes.
- B. Communication Cabinets: Nameplates.
- C. Conduit: Conduit markers.
- D. Control Device Station: Labels.
- E. Electrical Distribution and Control Equipment Enclosures, including panelboards, switchboards, switchgear, motor-control centers, control enclosures, communications enclosures, motor controllers, disconnect switches, remote control stations, etc.: Nameplates.
- F. Junction Box Load Connections: Wire markers.
- G. Outlet Box Load Connections: Wire markers.
- H. Panel Gutter Load Connections: Wire markers.
- I. Pull Box Load Connections: Wire markers.
- J. Panelboard branches: Circuit directory.
- K. Switchboard branches: Circuit directory or nameplates for individual overcurrent protective devices.

2 .2 NAMEPLATES AND LABELS

- A. Labels: All labels shall be permanent, and machine generated. **NO HANDWRITTEN OR NON- PERMANENT LABELS ARE ALLOWED.** Exception: back side of device plates and junction boxes may use handwritten, legible labeling on box covers, unless specifically prohibited by other specification sections.

- B. Nameplates: Engraved three-layer laminated plastic, 1/8" thick minimum, white letters on black background. Emergency systems including equipment and devices serving NEC 700 and 701 loads, white letters on red background.
- C. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
- D. Letter Size:
 - 1. Use 1/8 inch letters for identifying individual equipment and loads.
 - 2. Use 1/4 inch letters for identifying grouped equipment and loads.
 - 3. Use 3/8 inch letters for identifying panelboard designations.
 - 4. Use 3/4 inch letters for identifying switchboard, switchgear, and MCC designations.
- E. Labels: Machine generated adhesive labels with black letters on white background shall be permitted for device plates, 4-11/16" and smaller junction boxes, individual wall switches and receptacles, fire alarm devices, and control devices.

2.3 WIRE MARKERS

- A. Description: Vinyl cloth type self-adhesive wire markers.
- B. Description: Cloth, split sleeve, or tubing type wire markers.
- C. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
- D. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - 2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.4 PHASE IDENTIFICATION TAPE

- A. Provide thermoplastic color coding tape – Scotch #35 or equal.

2.5 UNDERGROUND WARNING TAPE

- A. Description: 6 inch wide polyethylene tape, detectable type (with continuous conductive metallic center core or foil backing), colored yellow, with suitable warning legend describing buried electrical lines.

2.6 ACCEPTABLE MANUFACTURERS

- A. 3M Corporation: www.3m.com
- B. Brady Corporation: www.bradycorp.com
- C. HellermannTyton: www.hellermannntyton.com
- D. Panduit: www.panduit.com
- E. Seton Identification Products: www.seton.com
- F. Thomas & Betts: www.tnb.com

3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels per label manufacturer's recommendations.

3.2 INSTALLATION

- A. Install nameplates and labels parallel to equipment lines.

- B. Secure nameplates to equipment front using screws, rivets, or adhesive.
- C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.
- D. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.

3.3 JUNCTION AND PULLBOX IDENTIFICATION

- A. Identify junction and pullboxes with circuit numbers and source panel designations for power wiring.

3.4 WIRING IDENTIFICATION

- A. Provide wire markers on each conductor or cable in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. Label wires and cables on each end within two to four inches of terminations.
- C. Color code electrical systems in accordance with the NEC.

480Y/277 Volt Systems	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral	Gray
208Y/120 Volt Systems	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral	White
240/120 Volt Systems	Phase A	Black
	Phase B	Red
	Neutral	White
All Systems	Ground	Green or bare copper
	Isolated Ground	Green with yellow stripe

- D. Wire sizes #6 and smaller shall have color coded insulation the full length of the wire.
- E. Wire size #4 and larger shall be identified with the appropriate color tape at all switchboards, panelboards, junction boxes, motor terminals, and any other enclosure where phase identification is necessary
- F. When wire of different systems junction in a common box, each cable shall be grouped with its own system and identified using tags or identification strips.

3.5 PANEL AND EQUIPMENT IDENTIFICATION

- A. Identify switchboards, panelboards, individual circuit breakers, enclosed switches, motor starters and other electrical enclosures using engraved laminated plastic nameplates, specified above, as follows:
 1. All distribution equipment (switchboards, panelboards, MCCs, etc.) with designation, voltage, and system (example: Panel A, 208Y/120V 3PH 4W).

2. Motor starters, individual circuit breakers in switchboards and MCCs, and enclosed switches with equipment served (0.75" high letters).
 3. Other enclosures with equipment designation and location being served.
- B. All permanently installed equipment (architectural, mechanical, electrical, etc.) shall have item designation and specific supply branch circuit or feeder identified at the disconnecting means or control device as appropriate.
- C. Equip each distribution, lighting, and lighting control panel with a clear plastic covered typewritten directory accurately indicating rooms and/or equipment being serviced.
1. Directory shall be based on Owner-approved final room numbers with the room numbers from the original construction documents in parentheses. Example: "Receptacles – Classroom 108 (A122)".
- D. When a piece of equipment is fed from more than one electrical source or more than one disconnect switch must be off to completely disconnect the equipment provide signs at each disconnect warning of this hazard.
- 3 .6 UNDERGROUND INSTALLATION
- A. Underground warning tape shall be placed above cables and conduits the full length of the trench at a depth of 12" below grade.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes short circuit and protective device coordination study encompassing portions of electrical distribution system from normal power source or sources up to and including breakers in service entrance switchboard, fuses in service entrance switchboard, main breaker in sub-distribution panels, fuses in sub-distribution panels and main breaker in each panelboard.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

1.3 DESIGN REQUIREMENTS

- A. Complete Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70.
- B. Report Preparation:
 - 1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
 - 2. Perform study with aid of computer software program.
 - 3. Obtain actual settings for all equipment incorporated into Work.
 - 4. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
 - a. Utility supply bus.
 - b. Medium voltage air interrupter switchgear.
 - c. Medium voltage circuit breaker switchgear.
 - d. Secondary unit substations.
 - e. Automatic transfer switch.
 - f. Manual transfer switch.
 - g. Engine generator.
 - h. Medium voltage motor controllers.
 - i. Low-voltage switchgear.
 - j. Switchboards.
 - k. Motor control centers.
 - l. Distribution panelboards.
 - m. Branch circuit panelboards.
 - n. Busway.

- o. Each other significant equipment location throughout system.
- C. Report Contents:
1. Include the following:
 - a. Calculation methods and assumptions.
 - b. Base per unit value selected.
 - c. One-line diagram.
 - d. Source impedance data including power company system available power and characteristics.
 - e. Typical calculations.
 - 1) Fault impedance.
 - 2) X to R ratios.
 - 3) Asymmetry factors.
 - 4) Motor fault contribution.
 - 5) Short circuit kVA.
 - 6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
 - 7) Tabulations of calculation quantities and results.
 - f. One-line diagram revised by adding actual instantaneous short circuits available.
 - g. State conclusions and recommendations.
 2. Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
 3. Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.
 4. Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
 5. Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:
 - a. Power company relay characteristics.
 - b. Power company fuse characteristics.
 - c. Medium voltage equipment protective relay characteristics.
 - d. Medium voltage equipment protective fuse characteristics.
 - e. Low voltage equipment circuit breaker trip device characteristics.
 - f. Low voltage equipment fuse characteristics.
 - g. Cable damage point characteristics.
 - h. Pertinent transformer characteristics including:
 - 1) Transformer full load current.
 - 2) Transformer magnetizing inrush.
 - 3) ANSI transformer withstand parameters.
 - 4) Significant symmetrical fault current.
 - i. Pertinent motor characteristics.
 - j. Generator characteristics including:
 - 1) Phase and ground coordination of generator protective devices.
 - 2) Decrement curve and damage curve.
 - 3) Operating characteristic of protective devices.
 - 4) Actual impedance value.
 - 5) Time constants.

- 6) Current boost data.
- 7) Do not use typical values for generator.
- k. Transfer switch characteristics.
- l. Other system load protective device characteristics.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Qualifications Data: Submit the following for review prior to starting study.
 1. Submit qualifications and background of firm.
 2. Submit qualifications of individual or individuals performing study.
- C. Software: Submit for review information on software proposed to be used in performing study.
- D. Product Data: Submit the following:
 1. Report: Summarize results of study in report format including the following:
 - a. Descriptions, purpose, basis, and scope of study.
 - b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
 - c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
 - d. Fault current calculations including definition of terms and guide for interpretation of computer printout.
- E. Submit copies of final report signed by professional engineer. Make additions or changes required by review comments.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with all applicable codes, standards, and requirements.
- B. Maintain one copy of each document on site.
- C. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of three years documented availability approved by Architect/Engineer.
- D. Perform study in accordance with IEEE 242.

1.6 QUALIFICATIONS

- A. Study Preparer: Company specializing in performing work of this section with minimum three years documented experience and having completed three projects of similar size and complexity within the past ten years.
- B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Michigan with minimum of five years experience in power system analysis.

- C. Demonstrate company performing study has capability and experience to provide assistance during system start up.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Complete study within two weeks after pre-installation meeting.
- C. Allow one week for review of completed study by Architect/Engineer.
- D. Submit short circuit and protective device coordination study to Architect/Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.
- E. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Architect/Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.9 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements
- B. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work with local power company.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

- C. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.
- D. Select each primary protective device for delta-wye connected transformer so device's characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.
- E. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.
- F. Separate medium-voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

3.2 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Perform field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Adjust settings in accordance with approved short circuit and protective device coordination study.

END OF SECTION

SECTION 26 05 83
EQUIPMENT WIRING CONNECTIONS

1 GENERAL

1 .1 SECTION INCLUDES

- A. Electrical connections to equipment.

1 .2 RELATED DOCUMENTS

- A. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables (600V and Less)
- B. Section 26 05 23: Control-Voltage Electrical Power Cables
- C. Section 26 05 34: Conduit for Electrical Systems
- D. Section 26 05 37: Boxes for Electrical Systems
- E. Section 26 27 26: Wiring Devices
- F. Section 26 28 17: Enclosed Circuit Breakers
- G. Section 26 28 18: Enclosed Switches

1 .3 REFERENCE STANDARDS

- A. NEMA WD 1: General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- B. NEMA WD 6: Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002.
- C. NFPA 70: National Electrical Code; National Fire Protection Association; 2008.

1 .4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

- A. See Division 1 and Section 26 05 00 for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 PRODUCTS

3.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for cord-connected equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Wire and Cable: As specified in Section 26 05 19.
- C. Flexible Conduit: As specified in Section 26 05 34.
- D. Boxes: As specified in Section 26 05 37.
- E. Wiring Devices: As specified in Section 26 27 26.
- F. Disconnect Switches: As specified in Section 26 28 18 and in individual equipment sections.

2.2 EQUIPMENT CONNECTIONS

- A. Provide field-installed disconnect switches unless indicated to be furnished with equipment.
 - 1. Refer to equipment connection schedule for specific requirements.

3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible metallic conduit (FMC). Use liquid-tight flexible conduit (LFMC) with watertight connectors in damp or wet locations, any motors 1/2 HP or larger, and any rooftop equipment whether exposed or internal.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section outlines the requirements for the lighting equipment control devices.

1.2 SUBMITTALS

A. Provide shop drawings with product data including wiring diagrams, electrical ratings, construction details and materials.

1.3 REFERENCES

A. Underwriters' Laboratories, Inc. (UL)

B. National Electrical Manufacturers Association (NEMA)

C. WD 7: Occupancy Motion Sensors Standard

D. National Electrical Code (NEC)

E. American National Standards Institute (ANSI)

F. ANSI/ASHRAE/IESNA Standard 90.1-2007: Comply with requirements for interior and exterior lighting control.

G. Michigan Uniform Energy Code (MUEC)

1.4 RELATED DOCUMENTS

A. Section 23 09 23: Direct-Digital Control System for HVAC

B. Section 23 09 93: Sequence of Operations for HVAC Controls

C. Section 26 09 19: Enclosed Contactors

D. Section 26 27 26: Wiring Devices

E. Section 26 50 00: Lighting

PART 2 PRODUCTS

2.1 ELECTRONIC INTERVAL TIMER SWITCHES:

A. Single gang decorator style face.

B. Pushbutton initiation of time cycle.

- C. Backlit LCD display of time remaining.
- D. 120/277 dual operation. Rated for 800 watts at 120 volts, 1200 watts at 277 volts.
- E. Provide power pack in applications requiring additional power capacity.
- F. Time selection of 5 minutes to 12 hours by back of device DIP switch. Set at 3 hours in mechanical rooms and at 15 minutes in all other locations unless otherwise noted.
- G. Set additional DIP switch positions or programming per Engineer direction.
- H. Color to be selected from manufacturer's standards by Architect at time of shop drawing submittal.
- I. Pre-approved products are Watt Stopper TS-400, Hubbell Building Automation TD200, Tork SSA100, Cooper Greengate TSW-MV, Sensor Switch PTS, or approved equal.

2.2 OCCUPANCY SENSORS

- A. The sensors shall be digital and have automatic adjustment of both the sensitivity and the time delay to suit the space into which they are installed. The sensors shall operate at 24VDC. They shall carry 5-year warranty. Approved manufacturers for occupancy sensors shall be Leviton, Hubbell Building Automation, Acuity Sensor Switch, Cooper Greengate, and Schneider Electric, and are subject to the individual approved model list below.
- B. Ultrasonic occupancy sensors shall operate on ultrasonic (operating at >30kHz at $\pm 0.005\%$) technologies. They can protrude maximum of 1.5 inches below ceiling. The sensors shall be digital and have automatic adjustment of both the sensitivity and the time delay to suit the space into which they are installed.
- C. Passive Infrared occupancy sensors shall operate on passive infrared technologies. They can protrude maximum of 1.5 inches below ceiling. The sensors shall be digital and have automatic adjustment of both the sensitivity and the time delay to suit the space into which they are installed.
- D. Dual technology occupancy sensors shall operate on both passive infrared and ultrasonic (operating at >30kHz at $\pm 0.005\%$) or microphonic technologies. They can protrude maximum of 1.5 inches below ceiling. The sensors shall be digital and have automatic adjustment of both the sensitivity and the time delay to suit the space into which they are installed.
- E. Provide SPDT auxiliary HVAC dry contacts on all sensors. All sensors grouped together as one zone (as shown connected on the drawings) shall have a unified status output on the auxiliary contacts. This shall be accomplished either by:
 - 1. providing all individual sensors with an isolated SPDT relay and paralleling the relay contacts of all sensors in the zone with specified occupancy sensor connecting cable, or
 - 2. providing one or more control packs with an isolated SPDT relay for the zone
- F. Coordinate complete catalog numbers with options, colors, and accessories as required by the drawings and/or specifications to provide a complete, compliant, and working system.

G. Occupancy Sensor Schedule, Ceiling Mount:

1. (OS1) – Dual technology, small coverage, directional, Leviton OSC05-M, Hubbell OMNI- DT500, Sensor Switch CM-PDT, Watt Stopper DT-300, Cooper Greengate OMC-DT-0701
2. (OS2) – Dual technology, medium coverage, omnidirectional, Leviton OSC10-M, Hubbell OMNI-DT2000, Sensor Switch CM-PDT, Watt Stopper DT-300, Cooper Greengate OMC- DT-2000
3. (OS3) – Dual technology, large coverage, omnidirectional, Leviton OSC20-M, Hubbell OMNI-DT2000, Sensor Switch CM-PDT-10, Watt Stopper DT-300, Cooper Greengate OMC-DT-2000, Schneider Electric SLSCDS2000
4. (OS4) – Ultrasonic or dual technology, small coverage, directional, Leviton OSC05-U, Hubbell OMNI-US500, Sensor Switch CM-PDT, Watt Stopper UT-300-1, Cooper Greengate ODC-U-series
5. (OS5) – Ultrasonic or dual technology, medium coverage, omnidirectional, Leviton OSC10- U, Hubbell OMNI-US2000, Sensor Switch CM-PDT, Watt Stopper UT-300-2, Cooper Greengate ODC-U-series
6. (OS6) – Ultrasonic or dual technology, large coverage, omnidirectional, Leviton OSC20-U, Hubbell OMNI-US2000, Sensor Switch CM-PDT-10, Watt Stopper UT-300-3, Cooper Greengate ODC-U-series, Schneider Electric SLSCUS2000
7. (OS9) – Infrared, high-bay coverage at 30-35’ height, omnidirectional, Hubbell WSPSM24V with WSPLENS360, Sensor Switch CM-6, Watt Stopper HB-300 with HB-L4

H. Occupancy Sensor Schedule, Wall Box Mount:

1. (\$OS) – Dual technology, small coverage, directional, single-gang wall switch, Hubbell LHMTS1, Sensor Switch WSD-PDT, Watt Stopper DW-100, Cooper Greengate ONW-D- 1001-MV-N, or approved equal.

I. Power Packs

1. The power pack shall contain a 20A 120/277VAC dual-voltage power supply and relay (coordinate voltage with load). The relay shall be rated for a full 20A for fluorescent ballast and incandescent loads.
2. The power pack shall employ minimum arc (“zero-crossing”) switching technology to minimize the effect of transient switching current on the relay contacts.
3. The power pack shall have an SPDT auxiliary HVAC relay to provide occupied status to lighting control systems and/or BMS/ATC system, if the relay is provided in the pack in lieu of in each sensor unit.

4. The power pack shall be UL listed for installation inside ballast compartment and shall be able to be installed inside or outside of a standard junction box.

J. Slave Relay Packs

1. The slave relay pack shall contain a 20A 120/277VAC relay (coordinate voltage with load). The relay shall be rated for a full 20A for fluorescent loads. 120V relays shall be rated for a minimum of 13A of incandescent load.
2. The slave relay shall be UL listed for installation inside ballast compartment and shall be able to be installed inside or outside of a standard junction box.

K. Protective Cages

1. Furnish wire protective cages with white paint finish where noted on Drawings.
2. Cages shall be manufactured by occupancy sensor manufacturer. Third-party cage manufacturers, Safety Technology, Inc. (STI) or equal, may be used if proper sensor coverage/operation is not affected and can be guaranteed by sensor manufacturer.

L. Low-Voltage Control Relay System

1. Low voltage control relays shall be provided as noted on the Drawings and the Light Fixture Schedule.
2. Relays shall be 277 volt with control voltage derived from the power line. Remote control of the relay shall be accomplished with a single two conductor low voltage cable to the lighting contactor.
3. Relays shall be Intelligent Lighting Controls Inc. #TR277 relay or equal with SSA switch adapter and necessary momentary switches.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Lighting controls shall be installed in accordance with requirements, NEC and local codes.
- B. Provide adjustments and commissioning of occupancy sensor systems to ensure proper operation. For all occupancy sensors requiring non-automatic adjustment at startup, a factory-qualified technician or representative of the manufacturer shall provide adjustments and commissioning.
- C. All commissioning shall be completed prior to the building's occupancy by the Owner. The contractor will be backcharged the cost of time, materials, and energy incurred either by the Owner or the Architect/Engineer as a result of untimely commissioning services.
- D. For low-voltage control relays, electrical contractor is responsible for running L.V. cable.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section encompasses the selection and installation of circuit breaker panelboards, and their circuit breakers.

1.2 SUBMITTALS

- A. Shop drawings for panel.
- B. Product data on circuit breakers.

1.3 REFERENCES

- A. UL 50: Cabinet and Boxes, Electrical
- B. UL 67: Panelboards
- C. UL 489: Molded Case Circuit Breakers and Circuit Breaker Enclosures
- D. NEMA PB 1: Panelboards.
- E. NEMA AB 1: Molded Case Circuit Breakers.

1.4 RELATED DOCUMENTS

- A. Section 26 28 17: Enclosed Circuit Breakers
- B. Section 26 43 13: Surge Protective Devices for Low-Voltage Electrical Power Circuits

PART 2 PRODUCTS

2.1 CIRCUIT BREAKER PANELBOARD

- A. Furnish and install distribution and power panelboards as shown on the plans. Panelboards shall be dead-front, safety type equipped with thermal magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule. Provide Type 1, Class I, UL listed.
- B. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the drawings. Bussing and neutral shall be fully rated throughout. All sections and branch units shall be bussed directly to bus structure. Main phase to phasing bus and neutral bus to be tin plated copper. Buses to be rated for the available short circuit current, but not less than 10,000 amperes symmetrical.

- C. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Recessed cabinets to be equipped with spring latch and tumbler lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. End walls shall be removable. Fronts shall be of code gauge, full finished steel with rust-inhibiting primer and baked enamel finish.
- D. Breakers shall be thermal magnetic type with inverse time limit characteristic on overloads and instantaneous magnetic trip on short circuit. Breakers shall have quick-make, quick-break toggle mechanism and be trip-free on overload or short circuit. Multi-pole breakers shall be common trip type, handle tie bars shall not be used. Provide interrupting rating for the available fault current but not less than 10kAIC for 120V, 10kAIC for 208V, 18kAIC for 277V, and 18kAIC for 480V breakers.
- E. Panel boards shall be fully rated for short circuit current. All breakers in the panel shall be fully rated to interrupt the available fault current.
- F. All panelboards shall be completely factory assembled with molded case circuit breakers. Provide mounting brackets, busbar drillings, filler pieces for unused spaces and ground bus.
- G. Lighting panels shall have circuits numbered vertically in three rows, (1, 3, 5 and 2, 4, 6, etc.) Branch runs shall be connected by circuit numbers indicated in home runs on drawings for maximum load balance.
- H. Circuits where receptacles are outdoors or in wet areas shall be ground fault interrupting type.
- I. Provide locking devices for 5% of the circuit breakers.
- J. Minimum circuit trip rating shall be 20 amps for power and lighting.
- K. Panelboards shall be Listed and Labeled and conform to latest NEC requirements.

2.2 SPD PACKAGE

- A. The following describes the requirements for an integrated Surge Protective Device (SPD) system as indicated on the drawings and schedules.
- B. Refer to Section 26 43 13 for SPD safety standards, suppressor features and electrical/performance requirements.
- C. The SPD applications covered under this Section include distribution and branch panel locations. SPDs shall be tested to demonstrate they are suitable for ANSI/IEEE C62.41 Category C (high) environments.
- D. SPDs shall be factory-installed within the panelboard by the manufacturer of the panelboard. A direct bus bar connection shall be used to mount the SPD component to the panelboard bus bar to reduce the impedance of the shunt path. SPD units that use a wire connection to the bus bar or an overcurrent protection device do not meet the intent of this specification.

2.3 MANUFACTURERS

- A. Equipment shall be manufactured by Schneider Electric Square D, Eaton Electrical, General Electric, Siemens, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with NEC, as shown on the drawings, and as herein specified.
- B. Balance the loads on all phases and rearrange branch circuiting if required, for balancing.
- C. Flush mounted panel shall have tubs set into walls, square with building lines, and front panel and trim will match with tub and wall.
- D. Provide minimum of six (6) spare 3/4" conduits from panel tub to above accessible ceiling for each recessed panel.
- E. All panels shall be so mounted that the top is no more than 72" above the finished floor line.
- F. Each panel shall be provided with a neatly typewritten directory identifying its circuit connections. Refer to Section 26 05 53.
- G. Panels shall be identified per Section 26 05 53.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section encompasses the selection and installation of wiring devices to include:

1. Wall Switches
2. Receptacles
3. Push Buttons & Selector Switches
4. Electronic Interval Timer Switches
5. Electronic Low-Voltage Wall Box Dimmers
6. Cover Plates
7. Time Switch

1.2 RELATED DOCUMENTS

A. Section 26 05 37: Boxes for Electrical Systems

1.3 REFERENCE STANDARDS

- A. UL 20: General-Use Snap Switches
- B. UL 498: Attachment Plugs and Receptacles
- C. UL 943: Ground-Fault Circuit-Interrupters
- D. NEMA WD 1: General Purpose Wiring Devices
- E. NEMA WD 6: Wiring Devices - Dimensional Requirements
- F. ANSI C 73 Series: American Standards on Plugs and Receptacles
- G. NECA 130-2010: Standard for Installing and Maintaining Wiring Devices

1.4 SUBMITTALS

A. Product data of all types of items supplied.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Standard switches shall be specification industrial grade, quiet operating, toggle type in totally enclosed thermoset plastic base of the following make and catalog number or approved equal:

- | | | | |
|--------------------|---|----------|---------------------|
| 1. Single Pole | 20 amp | 120/277V | Hubbell No. HBL1221 |
| 2. Two Pole | 20 amp | 120/277V | Hubbell No. HBL1222 |
| 3. Three Way | 20 amp | 120/277V | Hubbell No. HBL1223 |
| 4. Four Way | 20 amp | 120/277V | Hubbell No. HBL1224 |
| 5. SPDT Momentary | 20 amp | 120/277V | Hubbell No. HBL1557 |
| 6. SPDT Maintained | 20 amp | 120/277V | Hubbell No. HBL1385 |
| 7. | Low-voltage toggle, heavy-duty SPDT momentary contact, center position off, 3 amp, 24 volt AC/DC, Pass & Seymour 1081-series or Watt Stopper LVS-1-series | | |

- B. Locking Switches shall be specification industrial grade, quiet operating, locking type furnished with flat stamped steel key in totally enclosed thermoset plastic base of the following make and catalog number or approved equal:

- | | | | |
|--------------------|--------|----------|----------------------|
| 1. Single Pole | 20 amp | 120/277V | Hubbell No. HBL1221L |
| 2. Two Pole | 20 amp | 120/277V | Hubbell No. HBL1222L |
| 3. Three Way | 20 amp | 120/277V | Hubbell No. HBL1223L |
| 4. Four Way | 20 amp | 120/277V | Hubbell No. HBL1224L |
| 5. SPDT Momentary | 20 amp | 120/277V | Hubbell No. HBL1557L |
| 6. SPDT Maintained | 20 amp | 120/277V | Hubbell No. HBL1386L |

- C. Key Locking Switches shall be specification industrial grade, quiet operating, barrel or cylinder locking type furnished with key in totally enclosed thermoset plastic base of the following make and catalog number or approved equal:

- | | | | |
|----------------|--------|----------|------------------------|
| 1. Single Pole | 20 amp | 120/277V | Hubbell No. HBL1221RKL |
| 2. Two Pole | 20 amp | 120/277V | Hubbell No. HBL1222RKL |
| 3. Three Way | 20 amp | 120/277V | Hubbell No. HBL1223RKL |
| 4. Four Way | 20 amp | 120/277V | Hubbell No. HBL1224RKL |

- D. Pilot light switches shall be lighted jewel and a switch. The load and the indicator lamp should operate simultaneously.

- E. Color of devices shall be selected from standard manufacturer's color choices during submittal process.

- F. Reference to Hubbell devices has been used as a means of establishing the grades and types of devices for use on the project. Comparable devices of Pass & Seymour (PS20AC series), Leviton (1220-2 series), or Cooper Arrow Hart (AH1220 series) will be acceptable.

2.2 RECEPTACLES

- A. Standard Duplex Receptacle: Full gang size, specification industrial grade, polarized, duplex, parallel blade, grounding slot, back and side wired with solid brass grounding strap, rated at 20 amperes, 120 volts, to conform to NEMA WD-1. Receptacles shall be Hubbell (HBL5362), Cooper Arrow Hart (AH5362), Leviton (5362), Pass & Seymour (5362-A), or approved equal.
- B. Ground fault receptacle: Specification industrial grade, UL listed Class A with 5mA sensitivity, 20 ampere 120VAC rating grounded NEMA 5-20R. Must meet or exceed the current UL 943 Standard. Manufactured by Hubbell (GF20L series), Cooper Arrow Hart (VGF20 series), Leviton (7899 series), Pass & Seymour (2095 series), or approved equal.
- C. Provide tamper-resistant (TR), weather-resistant (WR), corrosion-resistant (CR), hospital grade, and/or isolated-ground (IG) equivalents of the above specified receptacles where required by NEC, drawings, and specifications.
- D. Color of devices shall be selected from standard manufacturer's color choices during submittal process.

2.3 PUSHBUTTON AND SELECTOR SWITCHES

- A. All pushbuttons and selector switches shall be of the 30mm industrial-duty modular type.
- B. The operator button shall be molded thermoset plastic and solid in color through the material. Painted buttons are not acceptable. Emergency stop buttons shall be red in color and have a mushroom type head. A suitable and clearly legible nameplate shall be provided for each button to designate its function.
- C. All contact blocks shall be made of molded high arc resistant material and shall have a minimum of one normally open and one normally closed contact with a continuous current rating of 10 amperes. All terminals shall be readily accessible. Contact blocks shall be easily changed or be arranged for the addition on contacts.
- D. Indicating lights shall be of the LED type.
- E. Pushbutton stations shall be of the (standard duty) oil tight type surface or flush mounted as specified. The enclosure for surface mounting shall be die cast, arranged for a threaded conduit entrance. Flush mounted pushbutton enclosures may be sheet steel. A lockout attachment with provisions for padlocking is to be furnished on the stop button to render the control inoperative with the lockout in place.
- F. Mount selector switches or pushbuttons on starter covers except where indicate otherwise.
- G. Acceptable manufacturers are Schneider Electric Square D, Eaton Electrical, Allen-Bradley, or approved equal.

2.4 ELECTRONIC INTERVAL TIMER SWITCHES

- A. Single gang decorator style face.
- B. Pushbutton initiation of time cycle.
- C. Backlit LCD display of time remaining.
- D. 120/277 dual operation. Rated for 800 watts at 120VAC, 1200 watts at 277VAC, 1/6 HP motor at 120VAC.
- E. Provide power pack in applications requiring additional power capacity.
- F. Time selection of 5 minutes to 12 hours by back of device DIP switch. Set at 3 hours in mechanical rooms and at 15 minutes in all other locations unless otherwise noted.
- G. Set additional DIP switch positions or programming per Engineer direction.
- H. Color to be selected from manufacturer's standards by Architect at time of shop drawing submittal.
- I. Pre-approved products are Watt Stopper TS-400, Hubbell Building Automation TD200, Tork SSA100, Cooper Greengate TSW-MV, Sensor Switch PTS, or approved equal.

2.5 ELECTRONIC LOW-VOLTAGE WALL-BOX DIMMERS

- A. Reverse-phase dimming type compatible with electronic power supplies/drivers, capable of controlling lighting intensity over the complete range from off to full brightness with integral on/off switch.
- B. Dimmer shall be preset type with level control and on/off switch, single-pole or 3-way as required.
- C. Suitable for mounting in single gang switch box.
- D. Rated at 600 watts, 277 VAC single phase, unless otherwise noted on Drawings.
- E. Acceptable products are:
 - 1. Leviton Renoir II Preset Slide series
 - 2. Pass & Seymour Titan series
 - 3. Lutron Nova series

2.6 COVER PLATES

- A. Stainless Steel: Type 302 or 430, No. 4 finish, 0.040 inch thick, accurately die cut, protected with release paper.
- B. Cast Metal: Die cast profile, ribbed for strength, flash removed, primed with grey enamel, furnished complete with four mounting screws.

- C. Gaskets: Resilient rubber or closed cell foam urethane.
- D. Steel: Hot dip galvanized, 1.25 oz/sq.ft. minimum.
- E. Flush Mounting Plates: Beveled type with smooth rolled outer edge, stainless steel.
- F. Surface Box Plates: beveled, steel, pressure formed for smooth edge to fit box.
- G. Weatherproof Plates: Cast metal, gasketed for receptacles, provide spring loaded gasketed doors.
- H. Wet location Plates: Die-cast metal, gasketed for receptacles, lockable, NEMA 3R rated, wet location rated with plug in use. Provide T&B Red Dot CKMUV or equal by Hubbell, Intermatic, Leviton, Pass & Seymour, or Cooper Arrow Hart.
- I. Security Cover Plate: 14 ga stainless steel similar to Kenall WPP.
- J. Acceptable manufacturers are Appleton, Cooper Arrow Hart, Hubbell, Cooper Crouse-Hinds, Leviton, Pass & Seymour, Steel City, or approved equal.

2.7 TIME SWITCH

- A. Time switch shall be 7-day electronic with carryover in the event of a power outage. Provide contacts rated 40 amperes inductive in a NEMA enclosure which shall be lockable with a padlock. Time switch shall be designed to skip contact actuation on selected days and shall be capable of 12 on/off cycles each 24 hour period. Switch shall be UL listed.
- B. Time switches shall be Tork, Intermatic, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All wiring devices shall be of one manufacture and shall be delivered to project in original cartons. Devices shall be in accordance with Electrical Symbol Legend.
- B. Mounting heights shall be as specified in Section 26 05 00, "Common Work Results for Electrical".
- C. Coordinate switch mounting location with architectural detail.
- D. Provide cover plates for all devices.
- E. The outdoor units to be enclosed in cast aluminum boxes with cast aluminum, weatherproof cover plates.
- F. Provide permanent barriers between adjacent switches on 240-volt service.
- G. Provide engraved plastic nameplate or cover plate for receptacles other than standard duplex receptacle. Refer to Section 26 05 53.

- H. Wall switches, controlling 277-volt lighting circuits on different phases, shall not be ganged in an outlet box. In areas requiring more than one circuit for 277 volt lights and requiring separate switching for control, each switch shall be mounted in a separate box with separate plate. Such switch installations shall be closely grouped, and carefully installed to provide a neat and level installation.

- I. Device plates of the one-piece type shall be provided for all outlets to suit the devices installed; do not use sectional type device plates. Screws shall be of metal with countersunk heads, in color to match the finish of the plates. Install plates with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices; plaster filling will not be permitted.

END OF SECTION

SECTION 26 28 17

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section encompasses the selection and installation of circuit breakers in their related enclosures.

1.2 SUBMITTALS

- A. Product data including applicable shop drawings.
- B. Coordination and characteristic curves for circuit breakers.
- C. Test reports.

1.3 RELATED DOCUMENTS

- A. Section 26 24 13: Switchboards
- B. Section 26 24 16: Panelboards
- C. Section 26 29 13: Enclosed Motor Controllers

1.4 REFERENCES

- A. NFPA 70: National Electrical Code (NEC)
- B. NEMA AB 1: Molded Case Circuit Breakers
- C. UL 489: Molded Case Circuit Breakers and Circuit Breakers Enclosures

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Molded Case Circuit Breakers:
 - 1. Molded case circuit breakers shall have overcenter, tripfree, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Two and three pole breakers shall be common trip.
 - 2. Construction shall be of a rugged, integral housing type molded insulating material, with silver alloy contacts, Arc quenchers and phase barriers for each pole.

3. Each circuit breaker shall have a permanent trip unit containing individual non-adjustable thermal and magnetic trip elements in each pole with a common trip bar for all poles and a single operator. Circuit breaker operating handles shall assume a center position when tripped. All breakers shall be calibrated for operation in an ambient temperature of 40°C. Magnetic trip shall be adjustable from 3X to 10X for breakers with 600 ampere frames and higher. Factory setting shall be HI, unless otherwise noted.
4. Breakers shall have removable lugs. Lugs shall be UL Listed for copper conductors. Breakers shall be UL Listed for installation of mechanical screw type lugs or crimp lugs.
5. Circuit breakers in panelboards shall be bolt-on type on phase bus bar and shall have minimum interrupting rating as follows:
 - a. 120 volt Breakers: 10,000 amperes symmetrical.
 - b. 208 and 240 volt Breakers: 10,000 amperes symmetrical.
 - c. 277 and 480 volt Breakers: 18,000 amperes symmetrical.
6. Provide ground fault interrupters for personnel protection with 4-6mA sensitivity.
7. For heat tracing applications (equipment protection), provide ground fault interrupters with 30mA sensitivity.
8. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory.

B. Low Voltage Power Circuit Breakers:

1. General: Circuit breakers shall be dead front, drawout, air interrupter, stored-energy type with solid state trip devices. Silver alloy contact surfaces.
2. Rating: Circuit breakers shall be 3-pole, 600 volts AC, 60-cycle with frame size, trip rating, system voltage, interrupting rating and type of operation as scheduled on the drawings.
3. Drawout Mounting: Provide a racking mechanism to position and hold the breaker in the connected, test, or disconnected position. Provide an interlock to prevent movement of the breaker into or out of the connected position unless the breaker is tripped open.
4. Trip Devices: Breakers shall be electrically and mechanically trip-free and shall have trip devices in each pole. Unless otherwise indicated, each breaker shall have over-current, short-circuit and integral ground fault trip devices. Trip devices shall be of the solid state type with adjustable pick-up settings. Except for the instantaneous trip, devices shall have time-delay band adjustment of minimum, intermediate, and maximum setting. Long-time delay element shall have inverse time characteristics.

5. Position Indicator: Provide a mechanical indicator visible from the front of the unit to indicate whether the breaker is open or closed.
 6. Trip Button: Equip each breaker with a mechanical trip button accessible from the front of the door which shall permit tripping of the breaker.
 7. Padlocking: Provisions shall be included for padlocking the breaker in the open position.
 8. Operation: Unless otherwise indicated on the drawings, breakers 1,600 ampere frame size and less shall be manually operated. Breakers larger than 1,600 ampere frame size shall be electrically operated.
 9. Trip Requirements:
 - a. Magnetic, static solid state tripping device.
- C. Options available for circuit breakers:
1. Shunt trip.
 2. Under-voltage trip.
 3. Auxiliary contacts, (1) N.O. and (1) N.C.
 4. Current limiters.
 5. Visible contacts.
 6. Electrical interlocks.
 7. Trip indicator, trip button.
 8. Line terminal shields.
 9. Line and load lugs suitable for use with copper conductors with standard copper pressure, set screw fastening, aluminum alloy, terminals.
 10. Mechanical interlocking of walking beam or sliding bar type
- D. Acceptable manufacturers are: Schneider Electric Square D, Eaton Electrical, ABB, General Electric, Siemens, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Circuit breakers to be mounted in enclosures, panels, motor control centers, or switchgear.
- B. Enclosure for circuit breaker shall be properly grounded.
- C. Attach handles so as not to interfere with cover plate or door.

- D. Properly mount circuit breaker so that acceptable electrical connection is made to bus work.
- E. Termination of breaker terminals shall be to industry standards.
- F. Installation shall be in accordance with NEC, as shown on the drawings, and as herein specified.
- G. Balance the load on all phases and rearrange branch circuiting if required, for balancing.

END OF SECTION

SECTION 26 28 18

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section encompasses all motor and general circuit disconnect switches including separately mounted disconnects and those mounted in motor control centers, panelboards and switchboards.

1.2 SUBMITTALS

- A. Provide shop drawings for approval for all disconnects not an integral part of equipment, including outline and mounting dimensions, wiring schematic diagrams and withstandability ratings.
- B. Provide product data for approval for all disconnects not an integral part of equipment.
- C. Provide typical test report data for all disconnects outlined above.
- D. Provide operational and maintenance data including renewal parts for all disconnects.

1.3 RELATED WORK

- A. Section 26 28 13: Fuses

1.4 REFERENCES

- A. UL No. 98: Enclosed Switches
- B. NFPA 70: National Electrical Code (NEC)
- C. NEMA KS 1: Enclosed Switches

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- A. The disconnect switches shall be safety type, NEMA type HD, Listed, with quick-make, quick-break operating handle, and mechanism forming an integral part of the box, not in the cover. The switches to have dual cover interlock to prevent unauthorized opening of door in the "ON" position or closing mechanism with door open. Handle position shall indicate if switch is ON or OFF. Switches shall have removable arc suppressors, where necessary to permit easy access to line-side lugs. Lugs shall be Listed for aluminum and/or copper cables and front removable. All current carrying parts shall be plated.
- B. The covers on NEMA 12 and 4 enclosures shall be attached with pin type hinges and on NEMA 3R enclosure covers shall be securable in open position. The disconnect switch type enclosures shall be made of the following steel: NEMA 4: Code gauge (UL 98) sheet steel, NEMA 12: Code gauge (UL 98) sheet steel, NEMA 3R: Code gauge (UL 98)

galvanized steel. All enclosures to be given a rust-inhibitive phosphate treatment and then a coat of baked-on- gray enamel.

- C. In acid and corrosive areas, the disconnect switch enclosures and operators shall be of fiberglass-reinforced polyester and be gasketed to protect the exterior mechanisms. In the acid areas the screws shall be non-metallic.
- D. Provide fusible disconnect switches with factory-installed rejecting type fuseholders for fuses which have adequate interrupting capacity for the application and have an adequate short circuit current withstand rating to meet or exceed the available short circuit current.
- E. Disconnect switches shall be provided with lugs suitable for the conductors used.
- F. Acceptable manufacturers are Schneider Electric Square D, Eaton Electrical, General Electric, Siemens, or approved equal.

2.2 BOX COVER FUSIBLE DISCONNECT SWITCHES

- A. The box cover units shall be Listed, complete with a SPST switch for disconnecting purposes, a socket for the plug fuse, and a cover for the plug fuse.
- B. The unit shall be designed to be installed on a single gang or 4" square box.
- C. Minimum electrical ratings: 125V, 15A, rated for use with up to 1/3 HP motors.
- D. Provide non-removable Type S fuse adaptor for Edison-base socket.
- E. Acceptable manufacturers are Cooper Bussmann, Littelfuse, Mersen, or approved equal.

PART 3 EXECUTION

3.1 APPLICATION

- A. Disconnect switches for motors 1/2 HP and larger shall be heavy duty safety switches, NEMA Type HD.
- B. Disconnect switches for motors rated 1/3 HP and less may be a box-cover fusible disconnect switch.

3.2 INSTALLATION

- A. Install motor and circuit disconnects in accordance with manufacturers recommendations and applicable codes.
- B. Provide suitable lugs for termination of equipment grounding conductors inside the switch enclosure. Neutral lugs or terminals that are bonded to the enclosure by means of a removable screw or strap shall not be acceptable for termination of equipment grounding conductors.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section describes the materials and installation requirements for surge protective devices (SPDs) for the protection of all AC electrical circuits from the effects of lightning induced currents, substation, switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
- B. The individual units shall be Listed and Labeled to UL Standard 1449 (Third Edition) Type 2, complimentary Listed under UL Standard 1283.

1.2 RELATED DOCUMENTS

- A. Section 26 24 13: Switchboards
- B. Section 26 24 16: Panelboards

1.3 REFERENCE STANDARDS

- A. UL 1449 (Third Edition)
- B. UL 1283
- C. NEMA LS 1
- D. ANSI/IEEE C62.41
- E. ANSI/IEEE C62.45
- F. NFPA 70: National Electrical Code

1.4 SUBMITTALS

- A. Shop drawings, product data and manufacturer's installation instructions shall be submitted for engineer's review.
- B. Provide actual let through voltage test data for both the ANSI/IEEE C62.41.2 Category C (high) and Category B waveforms, tested in accordance with ANSI/IEEE C62.45. Independent test results (not in-house tests) are preferred.
- C. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the devices noise attenuation exceeds 50 dB at 100 kHz.

- D. If a retrofit (surface) mounted unit is required, submit electrical/mechanical drawings showing unit dimensions, weights, installation details, and wiring configuration.

PART 2 PRODUCTS

2.1 ELECTRICAL REQUIREMENTS

- A. Unit operating voltage: refer to drawings for voltage, phase(s) and unit configuration.
- B. Maximum Continuous Operating Voltage (MCOV) shall be greater than 115% of the nominal system operating voltage.
- C. Protection Modes shall encompass all ten (10) modes (line-neutral, line-ground, neutral-ground) in wye or high-leg delta configurations, and all six (6) modes in delta or single-phase configurations.
- D. The maximum UL 1449 VPR for the device must not exceed the following:
- E.

PART 3 Modes	PART 4 208Y/1	PART 5 480Y/277	PART 6 120/24	PART 7 240/120V 3Ø
PART 8 L-N, L-	PART 9 700V	PART 10 1,200V	PART 11 700V	PART 12 700V (1000V
PART 13 L-L	PART 14 1,00V	PART 15 2,000V	PART 16 1,00	PART 17 1,200V

- F. Let Through Voltage based on ANSI/IEEE C62.41.2 and C62.45 recommended procedures for Category C (high) waveforms (20kV, 10kA combination wave) shall be less than:

PART 18 Modes	PART 19 208Y/120	PART 20 480Y/2
PART 21 L-N (internal type)	PART 22 650V	PART 23 1,100V
PART 24 L-N (external type)	PART 25 1,100V	PART 26 1,700V

- G. Let Through Voltage based on ANSI/IEEE C62.41.2 and C62.45 recommended procedures for Category B waveforms (6kV, 500A, 100kHz ringwave) shall be less than:

PART 27 Modes	PART 28 208Y/120	PART 29 480Y/2
PART 30 L-N (internal type)	PART 31 450V	PART 32 850V
PART 33 L-N (external type)	PART 34 650V	PART 35 1,000V

- H. Pulse life test: Capable of protecting against and surviving 20,000 ANSI/IEEE C62.41.2 Category C (high) transients without failure or degradation of clamping voltage by more than 5%.
- I. UL 1449 Nominal Discharge Current Rating (I_N): 20 kA
- J. Surge Current Capacity based on an 8x20 microsecond waveform shall not be less than:
 1. Service Entrance Panelboards/Switchboards, 1000 amps or greater – 400 kA per phase, 200 kA/mode.
 2. Service Entrance Panelboards/Switchboards, 800 amps or less – 250 kA per phase, 125 kA per mode.
 3. Branch or Distribution Panelboards, 400 amps or greater – 160 kA per phase, 80 kA per mode.

4. Branch Panelboards, 225 amps or less – 120 kA per phase, 60 kA per mode

2.2 PRODUCT DESIGN

- A. The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating SPD modules which do not provide a balanced impedance path to each MOV shall not be acceptable.
- B. Units shall have modular design with field-replaceable modules, one module per phase, minimum.
- C. Each unit shall include a high performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be at least 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. The unit shall be complimentary listed to UL 1283.
- D. No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
- E. Each unit shall be equipped with overcurrent fusing. All protection modes (including Neutral to Ground) shall be internally fused at the component level with the fuses allowing the suppressor's maximum rated transient current to pass through the suppressor without fuse operation. If the It characteristic is exceeded, the fusing shall be capable of opening and clear both high and low impedance fault conditions. The fusing shall be capable of interrupting up to 200 kA symmetrical fault current with 480 VAC applied. Conductor level fuses or circuit breakers internal or external of the SPD will not be acceptable. This engineer requires submittal documentation of the proper fuse coordination of actual fault tests from a nationally recognized testing laboratory for product pre-approval (before bids).
- F. Each unit shall provide the following three levels of monitoring:
 1. Continuous monitoring of fusing system.
 2. Internal infrared sensor system for monitoring all MOVs (including neutral to ground). The system must be capable of identifying open circuit failures not monitored by conventional fusing systems.
 3. Thermal detection circuit shall monitor for overheating in all modes due to thermal runaway.
- G. The manufacturer shall provide a full five (5) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical codes.
- H. The unit must be equipped with an audible alarm and transient event counter.
- I. The SPD device must include contacts (N.O. and N.C.) for remote annunciation of unit status. The remote alarm shall change state if any of the three monitoring systems detect a fault condition.

- J. Each suppression unit shall incorporate an integral test feature which verifies the operational integrity of the unit's monitoring system.

2.3 MANUFACTURERS

- A. Equipment shall be as manufactured by Schneider Electric Square D, Eaton Electrical, LEA International, Advanced Protection Technologies, Liebert, or General Electric.

PART 3 EXECUTION

3.1 SERVICE ENTRANCE

- A. Install one primary suppressor within the switchboard at each utility service entrance to the facility, according to manufacturer's recommendations.
- B. The suppressor shall be installed on the load side of the service entrance.
- C. Conductors between suppressor and point of attachment shall be kept short (12 inches maximum) and straight.
- D. The suppressor's ground shall be bonded to the service entrance ground.

3.2 SECONDARY DISTRIBUTION PANELS

- A. Install panelboards as required and according to manufacturer's recommendations. The SPD shall be integrated into panelboards designated as "surge-protected". The panelboard door shall close and latch fully. Any work required to meet this requirement shall be exclusively the responsibility of the manufacturer of the panel/SPD assembly.
- B. SPD devices shall be mounted directly to the panel's main phase buses.
- C. Neutral and ground shall not be bonded together at secondary panelboard locations.

3.3 RETROFIT APPLICATIONS

- A. Devices shall be mounted external of the switchboard or panelboard.
- B. Maximum conductor lead length between breaker and suppressor shall not exceed 14 inches. The suppressing device shall be directly nipped to side or bottom of the switchboard/panelboard.
- C. Provide a 30-amp breaker to feed the SPD. Confirm rating with manufacturer's installation recommendation.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 GENERAL

1.1 DESCRIPTION

- A. General: Work required under this Section consists of all materials, labor, equipment, supervision, fees, services, and all related items that are necessary and reasonably incidental to proper completion of all lighting work indicated on Drawings and described in specifications.
- B. Work Included: In general, this shall include, but is not limited to:
1. Interior lighting
 2. Exterior lighting
 3. Emergency lighting
 4. Exit lighting
- C. Fixture Schedule:
1. The Contractor may elect to submit to Engineer a substitute fixture for review. All submittals must be made within 10 (ten) days prior to the bid date to provide ample time for review and to issue an addendum incorporating the acceptable substitution(s).
 2. Substitution submittals shall consist of a physical description, dimensioned drawing and complete photometric and electric data of the proposed lamp and luminaire. Working samples of lamp and luminaire substitutions may also be supplied for visual check of finish and operating characteristics per architect/engineer's request. Photometric reports must list the actual candela values for the luminaire's distribution in at least three planes. Candela curves, footcandle and lumen tables and iso-footcandle contours are not acceptable. No substitutions will be considered without compliance with this paragraph! Contractor will be responsible for all costs (engineering time, manufacturer's costs, distributor costs, etc.) incurred to replace equipment not approved if the distributor, manufacturers rep., or subcontractor makes substitutions.
- D. Once bids are approved and shop drawings are processed, all lighting is to be ordered in a timely manner. The Contractor is then to inform the Engineer immediately in writing, the date when equipment orders are completed and delivery scheduled.

1.2 REFERENCE STANDARDS

- A. Fed. Spec. W-F-412E: Fixtures, Lighting, Incandescent Lamp Industrial
- B. Fed. Spec. W-F-1662A: Fixture, Lighting (Fluorescent, Alternating Current Recessed and Surface Ceiling)
- C. ANSI C 81: Electric Lamp Bases and Holders
- D. ANSI D 82: Lamp Ballasts
- E. UL 57: Electric Lighting Fixtures
- F. UL 496: Edison-Base Lampholders

1.3 SUBMITTALS

- A. Within 24 hours after receipt of the electrical/lighting bid, the low two (2) bidders are to submit a bid supplement listing each lighting fixture they have based their bid on. This shall cover each and every fixture tag.
- B. Provide shop drawings for processing for all building lighting units, including construction details, outline and mounting dimensions, instructions for installation and maintenance, rough-in requirements, ballast performance data, and lighting efficiency tables. Shop Drawings shall be submitted in booklet form. This is to include all interior and exterior fixture types.
- C. Provide written documentation regarding the loading specifications and installation requirements for the suspension assembly of suspended indirect/direct fixtures.

1.4 WARRANTIES

- A. All interior and exterior lighting units shall be fully warranted against defective workmanship and materials for a period of one (1) year from date of on-site energization (substantial completion date).

1.5 PROTECTION

- A. Protect lighting fixtures and work against dirt, water or mechanical damage before, during, and after installation. Damage prior to final acceptance shall satisfactorily be repaired or replaced at no cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS AND FIXTURES

- A. General:
 - 1. Provide all lighting fixtures in accordance with Lighting Fixture Schedule and as indicated and required on Drawings.

2. Fixture catalog numbers only indicate type and style. Provide each fixture complete with proper fixture trim, levelers, mounting brackets, flanges, plaster rings, glassware, step- down transformers and accessories for complete installation as required for type of ceiling, room finish schedules and voltages available.
3. All plastic diffusers used in lighting fixtures shall be manufactured of 100 percent virgin acrylic plastic and shall carry State Fire Marshal approval affidavit.
4. Provide approved enclosures where recessed in fire rated ceilings.
5. Provide gaskets as required to prevent light spill between frames and ceilings.
6. Provide “damp” or “wet” labels on all fixtures installed outdoors or in moist areas (showers, exterior soffits, etc.).
7. Provide continuity of ground on all fixtures used as raceways and mounted end to end.
8. All metal parts to be chemically treated with a rust resistant phosphatized solution, reflecting surfaces to have factor of minimum 89%.
9. All 1' x 4', 2' x 2', and 2' x 4' troffers and parabolic luminaires and direct/indirect luminaires shall be painted after fabrication.
10. Refer to the Luminaire Schedule.

B. Lamps:

1. Provide lamps in all fixtures and lamp outlets of proper type voltage, color temperature, and wattage required for fixtures as indicated in Fixture Schedule or as indicated on Drawings.
2. All fluorescent lamps shall be General Electric, Sylvania, or Philips.
3. All HID lamps shall be General Electric, Sylvania, Venture, EYE, or Philips.
4. All incandescent and quartz lamps shall be General Electric, Sylvania, Ushio, or Philips.
5. Provide a typewritten label for each fixture with lamp ordering code number for future maintenance. Locate the label so that it cannot be seen from normal viewing angles.
6. Contractor shall provide 5% replacement lamps of all lamp types to the Owner upon completion of the job.

C. Fluorescent Ballasts:

1. Fluorescent ballasts shall be fully electronic, fault tolerant, operating at 40kHz frequency or greater with less than 2% lamp flicker and lamp current crest factor less than 1.7.

2. Ballasts shall be dual-voltage 120/277V at an input frequency of 60 Hz, and light output shall remain constant for line voltage fluctuation of +/- 5%. Power factor shall be 0.99 nominal. Total harmonic distortion shall be less than 10%, with third harmonic distortion less than 8%.
3. Ballasts shall be full Programmed Start type and maintain partial cathode heat during operation. Minimum starting temperature shall be 0°F or less.
4. Ballasts shall comply with EMI and RFI limits set by the FCC and NEMA and not interfere with normal electrical equipment, comply with applicable ANSI standards, have "A" or better sound rating, and have profile height less than 1.5".
5. Listed and Labeled as Class P - Type I outdoor.
6. Three year manufacturer warranty, minimum, required.
7. Ballast efficiency shall be greater than 91%. All ballasts shall be "NEMA Premium" compliant where available for the lamp type.
8. Acceptable fixed-output (0.88 ballast factor, unless otherwise indicated) products for T8 lamps are:
 - a. Advance Optanium 2.0
 - b. Sylvania Quicktronic Professional PROStart Universal
 - c. Universal Triad AccuStart8
 - d. GE UltraStart T8 Multivolt
9. Acceptable fixed-output (1.00 ballast factor, unless otherwise indicated) products for T5 lamps are:
 - a. Advance Centium
 - b. Sylvania Quicktronic Professional PROStart Universal
 - c. Universal Triad AccuStart5
 - d. GE UltraStart T5 Multivolt
10. Acceptable fixed-output (1.00 ballast factor, unless otherwise indicated) products for compact (T4 and TT5) lamps are:
 - a. Advance Smartmate
 - b. Sylvania Quicktronic Professional PROStart/CF
 - c. Universal Triad
 - d. GE Multivolt ProLine CFL

11. See Fixture Schedule for other requirements.

D. High Intensity Discharge (HID) Ballasts:

1. Shall comply with ANSI C82.4 and be Listed and Labeled to UL 1029.
2. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of +/- 5%.
3. Power Factor: Not less than 0.90 unless otherwise indicated.
4. Ballast Factor: 1.00 unless otherwise indicated.
5. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of -22 degrees F.
6. Electromagnetic metal halide ballasts shall be pulse-starting type (example: HX for lower wattage MH lamps, SCWA for higher wattage MH lamps).
7. See Fixture Schedule for other requirements.

E. Fusing

1. All HID fixtures shall be provided with inline fuses installed in each phase conductor, with each fixture fused individually.
2. Fusing shall be located inside the handhole of the pole if pole-mounted; otherwise, within the fixture.
3. Refer to Section 26 28 13 "Fuses" for specifications.

F. Emergency Lighting:

1. Emergency lighting systems shall be as indicated on Drawings, complete with all equipment, including fixtures, lamps, batteries, conduit, boxes and wiring.
2. This equipment is to provide instantaneous emergency lighting in the event of a power failure by means of direct bypass or transfer to the emergency power system and by means of batteries with solid-state controls where indicated in specific areas in addition to the emergency power system.
3. Fluorescent emergency battery pack shall consist of a field replaceable, high temperature, maintenance-free nickel cadmium battery, charger and electronic circuitry contained in a single metal case. A solid-state charging indicator light to monitor the charger and battery, a double-pole test switch, and installation hardware shall be supplied. A minimum of a 5- year full manufacturer warranty shall be provided.
4. The emergency battery pack shall be capable of producing the rated output for a minimum of 90 minutes and shall be Listed to UL924 standards.
5. Emergency battery pack shall be installed inside the ballast compartment of the light fixture. Where the size of the emergency battery pack prohibits installation

inside the ballast compartment, the emergency battery pack shall be installed remotely from the fixture ballast compartment in an accessible location (i.e. above a lay-in ceiling when used with a recessed fixture). Provide flexible metallic conduit for interconnecting fixture to battery pack in remote situations.

6. Refer to the following chart for required lumen outputs. Where a discrepancy occurs between the drawings and this spec, the higher required lumen output takes precedence.

	MINIMUM TOTAL
54 watt T5HO lamp	1250
28 watt T5 lamp	1200
32 watt T8 lamp (where emergency ballast may be installed in fixture)	1400
32 watt T8 lamp (where emergency pack must be installed remotely from the	3000
17 watt T8 lamp	1050
PL-L/Biaxial Fluorescent Lamps	1800
PLT/TRT Compact Fluorescent Lamps	750
PL-C/Quad Tube Compact Fluorescent	600
PL Compact Fluorescent Lamps	500

G. Exit Lighting:

1. Exit light system shall be as indicated on Drawings.
2. Equipment shall be complete with L.E.D. lamps, 4 watts maximum.
3. Where indicated as such, provide integral battery pack, and charge for illumination under power failure conditions.
4. Exit signs with integral emergency battery packs shall have integral self-diagnostic circuitry and bi-color status indicator (multiple flash rates).
5. Equipment shall meet OSHA, NFPA, and NEC illumination standards.
6. Equipment shall carry the “Energy Star” approval rating as defined by the U.S. Environmental Protection Agency and U.S. Department of Energy.

H. Site Poles:

1. General:
 - a. Wind loading shall be calculated for 90 mph wind plus a 30% gust factor with AASHTO standard specification for structural supports for highway signs, luminaries, and traffic signals.

- b. Effective projected area (EPA) shall be defined as the actual area adjusted with the appropriate drag coefficient (shape factor) to result in an equivalent area having a drag coefficient equal to one (1.0). This rating shall be used to determine the required wall thickness of any pole.
 - c. Color to be determined by Architect/Engineer during shop drawing review.
2. Aluminum/Steel Materials:
- a. The surface of the pole will be smooth finish and uniform the entire length of the pole.
 - b. Where applicable, the pole shall be delivered predrilled to accommodate the specified lighting fixture(s) or mast arm(s).
 - c. The handhole shall be 2-1/2" x 5" with an oval A319 cast aluminum cover secured with a vandal resistant stainless steel 1/4" socket head screw.
 - d. Anchor bolts shall conform to ASTM A307 with threaded end, hex nuts, and flat washers (two per bolt) each galvanized to ASTM A153. A bolt hole template shall be furnished with the anchor bolts.

PART 3 EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Examine architectural and other pertinent details and confirm with general and ceiling and wall construction and finish being installed.
- B. Lighting fixture catalog numbers and mounting indicated on the electrical Drawings are for general bidding information only.
- C. It shall be the Contractor's responsibility to determine what suspension or mounting method is required and provide fixtures complete with all trim, flanges, brackets, levelers, etc. required for mounting at the location indicated.

3.2 BASIC INSTALLATION METHODS AND MATERIALS

- A. General: Install outlets, surface mounted, recessed or semi-recessed fixtures to maintain the alignment, spacings, layout, and general arrangement indicated on the Drawings; obtain approval of Engineer for all changes in layout required to avoid interferences with other trades.
- B. Coordination:
 - 1. Work incorporating with ceiling trades in locating and framing recessed fixtures in acoustical tile pattern or grid system to conform to layout.

2. Inform affected trades of the location and framing details necessary for the installation of flush fixtures and delivery of all framing rings of these fixtures that become a part of the ceiling construction.
3. Before equipment is ordered, electrical contractor to review luminaire and ceiling mechanical compatibility in each area and verify luminaire ordering code numbers with the ceiling system shown on the drawings. Contractor shall be responsible for all fixture quantities, lengths, and clearances required and shall inform the Architect of the job conditions at variance with the fixture(s) specified or detailed which affect installation or location. (All stages of installation.)
4. The contractor shall be responsible for contacting Engineer regarding the proper interpretation of all information indicated on the lighting layout, fixture schedule, fixture cuts, details and specifications.
5. Mechanical and Electrical Contractor are to review and coordinate lighting locations in relationship to mechanical systems to minimize conflicts prior to installation. Electrical Contractor is to submit a written memo with minutes of these meetings to both the Architect and Engineer.

C. Installation:

1. Installation shall be in accordance with the NEC, and as shown on the drawings.
2. Install fixtures in a workmanlike manner. Install outlets, surface-mounted, recessed or semi-recessed fixtures to maintain the alignment, spacings, layout and general arrangement shown on the Plans; obtain approval of Architect/Engineer for any changes in layout required to avoid interferences with other trades. Surface fixtures shall be securely mounted and shall not rotate on single box connections. Additional fastening shall be installed by the Contractor, if necessary, to secure fixture.
3. Deliver lamps to the project in the original cartons and install in the fixtures just prior to the completion of the project. At the option of the Contractor, the permanent fixtures, installed as part of the contract, may be lamped and used for construction lighting, however, all burned out incandescent lamps shall be replaced prior to occupancy and all fluorescent, H.I.D. or quartz lamps, failing within three months after occupancy, shall be replaced by the Electrical Contractor.
4. Aim adjustable lighting fixtures as directed by the Architect/ Engineer and, if necessary, make adjustments at night time.
5. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.

D. Mounting and Supports:

1. Fixtures shall be securely mounted to elements of the building structure or to suspended ceiling systems such that said fixture will be square, plumb, and rigid; will not fall or sag; and will not cause the suspended ceiling system to sag.

2. Furnish and install all additional means necessary to support lighting fixtures that would put excessive stress on the ceiling system.
 3. Provide support from the structural system above where H.I.D. fixtures are recessed in suspended ceilings.
 4. Surface mounted or suspended fixtures shall be rigidly supported from the structural system above.
 5. Where lighting fixtures are indicated for installation in continuous rows, insure that the installation results in a uniform and continuous straight row without vertical or horizontal variation, with lighting fixtures installed end to end. (Maximum of 6" at end of runs.)
- E. Emergency systems raceway and hook-up:
1. Circuit wiring for the emergency systems shall be installed in separate raceway and kept entirely independent of all other wiring and equipment.
 2. Replace all burned out incandescent and dimmed lamps.
- F. Testing:
1. After completion of the exit light and emergency light system, the Electrical trades shall test the various systems and submit written reports of findings.
 2. Testing shall be as follows: Turn off the normal power to the areas covered by emergency lighting equipment and test emergency lighting and exit lights for 1-1/2 hours. Check intensity, aiming and recharging after use.

3.3 CLEANING

- A. At project completion, before final approval:
1. Clean the interior of all fixtures, all lens and lamps.
 2. For surface, pendant hung, and/or chain hung fixtures, clean exterior of fixture(s).

END OF SECTION

SECTION 31 05 13

AGGREGATES FOR EARTHWORK

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Site berming.
- B. Fill under roadways, driveways, sidewalks, parking lots, and other traveled surfaces.
- C. Fill for over-excavation.
- D. Fill for subgrade undercutting.
- E. Consolidation and compaction.

1.2 RELATED SECTIONS

- A. Section 312316 - Excavation.
- B. Section 312317 - Trenching: Backfilling of utility trenches.
- C. Section 331116 - Water Distribution: Pipe bedding.
 - 1.

1.3 REFERENCES

- A. ANSI/ASTM C117 - Test Method for Materials Finer than 75 mm (No. 200) Sieve in Mineral Aggregates by Washing.
- B. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. MDOT current Standard Specifications for Construction.
- D. ASTM D2992 - Test Methods of Density of Soil and Soil - Aggregate in Place by the Nuclear Method (Shallow Depth).

2. PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Type A - Coarse Stone Fill: MDOT 6A compacted crushed limestone - for wet excavation, pipe bedding, refill for poor soil or over excavation in pipe trench, compacted to 95 percent of maximum density. A ballast type crushed limestone free of shale, clay, friable material, sand debris graded in accordance with ANSI/ASTM C136.

- B. Type B - Engineered Fill: MDOT Class II - for dry excavation, compacted to 95 percent of maximum density.
- C. Type C - Acceptable Native Subsoil: Reused, free of gravel larger than 3 inch size, and debris, compacted to 95 percent of maximum density.
- D. Type D - Dense Aggregate: MDOT 22A compacted crushed limestone - for access roads temporary patches on traveled surfaces and aggregate base course of asphalt pavement compacted to 95 percent of maximum density.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify fill materials to be reused are acceptable.

3.2 PREPARATION

- A. Thoroughly proof-roll all areas of concrete pavement, bituminous pavement, concrete curb and gutter and sidewalks with a fully loaded tandem-axle truck, or its equivalent.
- B. Loose or soft areas revealed during the proof-rolling operations are to be compacted or removed and replace with compacted Type B or C fill.
- C. Install geotextile fabric between subgrade and aggregate in parking and drive areas as specified by the Soils Engineer.
- D. Prior to placement of fill material in building and paved areas, compact upper 12 inches of the subgrade to 95 percent of its maximum dry density as determined by MDOT Standard Requirements.

3.3 BACKFILLING

- A. Backfill areas to proposed subgrade with unfrozen materials.
- B. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Engineered Type B Fill: Place and compact materials in continuous layers not exceeding 9 inches compacted depth.
- D. Acceptable Native Subsoil Type C Fill: Place and compact material in continuous layers not exceeding 9 inches compacted depth.
- E. Employ a placement method that does not disturb or damage utilities in trenches.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Backfill against supported foundation walls.

- H. Make grade changes gradual. Blend slope into level areas.
- I. Slope fill away from structures a minimum 2 inches in 10 feet.
- J. Leave fill material stockpile areas completely free of excess fill materials.

3.4 TOLERANCES

- A. Top surface of fill for building pads plus or minus 1/4 inch from require elevation.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1/2 inch from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under contract provisions.
- B. Tests and analysis of fill material will be performed in accordance with the current MDOT Standard Specifications For Construction.
- C. Compaction testing will be performed in accordance with the current MDOT Standard Specifications For Construction .
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- E. Frequency of Tests: As directed by the Soils Engineer.

3.6 PROTECTION OF FINISHED WORK

- A. Protect finished Work.
- B. Recompect fills subjected to vehicular traffic.

3.7 SCHEDULE

- A. Fill Under Grass Areas:
 - 1. Subsoil Type C fill, to 6 inches below finish grade, compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.
- B. Fill Under Landscaped Curb Island Areas:
 - 1. Type C fill, to 12 inches below finish grade, compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.
- C. Fill Under Asphalt Paving:
 - 1. Type B or C fill, to underside of aggregate base course elevation, compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.

- D. Fill Under Concrete Curb and Gutter and Sidewalks:
 - 1. Type B or C fill, to within 4" of underside of concrete slab. All fill to be compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.

- E. Backfill for Utility Trenches:
 - 1. Bedding as specified in individual utility specification section.
 - 2. Backfill material as specified in Section 02225 - Trenching and as defined here in for typed fill.

- F. Fill for Subgrade and Undercutting:
 - 1. Type B fill to proposed subgrade elevation, compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Remove surface debris.
- B. Remove paving, curbs, sidewalks.
- C. Clear site of plant life and grass.
- D. Remove trees and shrubs.
- E. Remove root system of trees and shrubs.

1.2 RELATED SECTIONS

- A. Section 312213 - Rough Grading.
- B. Section 312316 - Excavation.
- C. Section 312500 – Soil Erosion and Sedimentation Control

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable code for disposal of debris.
- B. Coordinate clearing Work with utility companies.

2. PART 2 EXECUTION

2.1 PREPARATION

- A. Verify that existing plant life designated to remain, is tagged or identified.

2.2 PROTECTION

- A. Locate, identify, and protect utilities that remain, from damage.
- B. Protect survey stakes.
- C. Protect trees, plant growth, and features designated to remain, as final landscaping.
- D. Protect bench marks and existing structures from damage or displacement.

2.3 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove paving, curbs, sidewalks.
- C. Remove trees as specified on drawing. Remove tree stumps.
- D. Clear undergrowth and deadwood, without disturbing subsoil.
- E. Remove all cleared items from site and properly dispose.

3. PART 3 EXECUTION

- 1. Not Used.

END OF SECTION

SECTION 31 23 13

ROUGH GRADING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of topsoil and subsoil.
- B. Cutting, grading, filling and rough contouring the site, including grading for valley-shaped ditches.

1.2 RELATED SECTIONS

- A. Section 311000 – Site Clearing.
- B. Section 312316 – Excavation.
- C. Section 310516 - Aggregate for Earthwork.
- D. Section 312317 – Trenching.

1.3 REFERENCES

- A. MDOT Standards.

1.4 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of utilities remaining, by horizontal dimensions, elevations or inverts, and slope gradients.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Excavated material, graded, free of roots, rocks larger than 1 inch (25 mm), subsoil, debris, and large weeds.
- B. Subsoil: Excavated material, graded, free of lumps larger than 6 inches (150 mm), rocks larger than 3 inches (75 mm), and debris.
- C. Granular Fill: Type B specified in Section 310516 - Aggregate for Earthwork-MDOT Class II for dry excavation. Type A specified in Section 310516 - Aggregate for Earthwork - MDOT 6A compacted crushed limestone for wet excavation.
- D. Coarse Aggregate: Type A MDOT 6A compacted crushed limestone for wet excavation specified in Section 310516 - Aggregate for Earthwork.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.
- B. Verify that fill materials to be used are acceptable.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known underground, above ground and aerial utilities. Stake and flag locations.
- C. Notify utility company to remove and relocate utilities.
- D. Protect above and below grade utilities that are to remain.
- E. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- F. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavation equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded marked areas.
- B. Stockpile in area designated on site or as approved by the Engineer. Remove excess topsoil not being reused from site.
- C. Do not excavate wet topsoil.
- D. Stockpile topsoil for reuse on site to depth not exceeding 8 feet (2.5 m).

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.
- B. Stockpile in area designated on site or as approved by the Engineer.
- C. Do not excavate wet subsoil.
- D. When excavation through roots is necessary, perform work by hand and cut roots with sharp axe.

3.5 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Granular Fill: Place and compact materials in continuous layers not exceeding 12 inches compacted depth, compacted to 95 percent.
- C. Subsoil and Topsoil Fill: Place and compact material in continuous layers not exceeding 12 inches compacted depth, compacted to 95 percent.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from buildings and structures minimum 2 inches in 10 ft, unless noted otherwise.
- F. Make grade changes gradual. Blend slope into level areas.
- G. Remove surplus and unsuitable fill materials from site.
- H. The Owner may have a use for the surplus excess excavated material. If they do it shall be their property and the Contractor's responsibility to transport said material to the Owner's stockyard. All cost associated with transporting, hauling, and loading said material shall be included in other pay items of this project.

3.6 SPOIL LEVELING

- A. As indicated on Drawings, or as directed by Engineer.
- B. Contractor shall be responsible for loading, hauling and spreading of all excess excavated material generated from this project.
- C. Place no excavated materials on roads without written permission of the authorities having jurisdiction of said road.
- D. Remove excavation in areas adjacent to yards where there is no suitable place to deposit spoils and dispose of as indicated on the drawings or off site as directed by the Engineer.
- E. Place no spoils in a watercourse or drain.

3.7 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot.

3.8 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with ANSI/ASTM D2992.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

C. Frequency of Tests: As directed by the owners onsite representative.

END OF SECTION

SECTION 31 23 16

EXCAVATION

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation for:
 - 1. Roadway
 - 2. Water Main.
 - 3. Sanitary Sewer
 - 4. Storm Sewer
 - 5. Other Structures.

1.2 RELATED SECTIONS

- A. Section 31 23 16 - Rough Grading: Topsoil and subsoil removal from site surface.
- B. Section 31 05 16 - Aggregate for Earthwork.
- C. Section 31 23 17 - Trenching: Excavation for utility trenches.

2. PART 2 PRODUCTS

2.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known underground, above ground, and aerial utilities, stake, and flog locations.
- C. Notify utility company when specified to remove and relocate utilities.
- D. Protect above and below grade utilities which are to remain.
- E. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- F. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- G. Protect grade and slope stakes.
- H. Clear site in accordance with Section 31 10 00 - Site Clearing.
- I. Excavate roadway to the dimensions and cross sections specified on drawings.

- J. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- K. Correct unauthorized excavation at no extra cost to Owner.

2.2 SPOIL LEVELING

- A. Seed spoils in accordance with landscape requirements.
- B. Spoils placed on tillable land shall be spread evenly as shown on plans.
- C. Spoils shall be stockpiled as shown on plans.
- D. No excavated materials shall be placed on roads .
- E. No spoils are to be placed in any watercourse or drain.
- F. Non-combustible items (i.e. roots and stumps), brush, or debris shall not be mixed with leveled spoil material.
- G. Shape leveled spoils to prevent the ponding of water behind spoil pile.
- H. In agricultural areas, root rake and hand pick sticks and rocks so that foreign debris 1' in length and/or 6" in diameter is disposed of.

2.3 FIELD QUALITY CONTROL

- A. Field inspection will be performed under contract provisions.
- B. Provide for visual inspection of bearing surfaces.

2.4 PROTECTION

- A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation, from freezing.
- C. Protect landscape areas, mailboxes, trees, lawns, etc. Any damage to these areas becomes the responsibility of the Contractor.

2.5 DUST CONTROL

- A. The Contractor shall implement measures to minimize dust, especially near residences.

END OF SECTION

SECTION 31 23 17

TRENCHING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavate trenches for utilities to the line and grade shown on the drawings.
- B. Compacted bedding under fill over utilities to the elevation shown on the drawings and described in the specifications.
- C. Backfilling and compaction.

1.2 RELATED SECTIONS

- A. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
- B. Section 31 23 16 - Excavation: General building excavation.
- C. Section 31 05 16 - Aggregate for Earthwork.

1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 kg) Rammer and 12 inch (304.8 mm) Drop.
- C. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- D. ASTM D2922 - Test Methods of density of Soil and Soil - Aggregate in Place by Nuclear Methods (Shallow Depth).

1.4 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings.

2. PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Types A, B, C, D, materials as specified in Section 31 05 16.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that fill materials to be reused are acceptable.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.

3.3 EXCAVATION

- A. Excavate subsoil required for storm sewer, piping, and accessories as indicted on the drawings.
- B. Excavate on the required line to the depth required below the pipe grade for bedding thickness required.
- C. Cut trenches a minimum of 12" wider than the outside diameter of the pipe being installed.
- D. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- E. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- F. Remove lumped subsoil, boulders, and rock 6 inches below bottom of pipe.
- G. Where soil in the bottom of the trench is unstable, excavate below the trench bottom and place Type A fill.
- H. Correct unauthorized excavation at no cost to Owner.
- I. Correct areas over-excavated by error in accordance with Section 31 23 16, with Type A fill.
- J. Stockpile excavated material in area designated on site and remove excess material not being used, from site.
- K. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- L. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

- M. Protect excavation by methods required to prevent cave-in or loose soil from falling into excavation.

3.4 BEDDING

- A. Support pipe and conduit during placement and compaction of bedding fill.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen Type B materials unless noted otherwise.
- B. Backfill trenches under all traveled surfaces, roads, parking areas, and driveways with Type B fill.
- C. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- D. Use no foreign or perishable material in backfilling.
- E. Place geotextile fabric over Type A fill prior to placing next lift of fill.
- F. Supply additional backfill material at no additional cost should the quantity and quality of material excavated from the trench be less than that needed to backfill to grade.
- G. Granular Fill: Place and compact materials in continuous layers not exceeding 12 inches to 95 percent of maximum dry density as determined by ASTM D2992.
- H. Soil Fill: Place and compact material in continuous layers not exceeding 12 inches compacted depth.
- I. Employ a placement method that does not disturb or damage foundations, conduit in trench, and structures, installed utility, and existing utilities in trench.
- J. Maintain optimum moisture content of backfill materials to attain required compaction density.
- K. Remove surplus backfill materials from site.
- L. Leave fill material stockpile areas completely free of excess fill materials.
- M. Backfill simultaneously around all sides of structures, manholes, and catch basins.

3.6 TOLERANCES

- A. Top Surface of Backfilling: Plus or minus ½ inch from required elevations.

- B. Top Surface of General Backfilling: Plus or minus one inch from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under contract provisions.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D2992.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- D. Frequency of Tests: as directed by the Owner onsite representative.

3.8 PROTECTION OF FINISHED WORK

- A. Protect finished Work.
- B. Recompact fills subjected to vehicular traffic prior to placing wearing surface.

END OF SECTION

SECTION 31 23 23

FILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backfilling site structures to subgrade elevations.
 - 2. Fill under slabs-on-grade.
 - 3. Fill under paving.
 - 4. Fill for over-excavation.
 - 5. Consolidation and Compaction.
 - 6. Fill Under Roadways, Driveways, Sidewalks, Parking Lots, and Other Traveled Surfaces.
 - 7. Utility Trench Backfilling.
 - 8. Fill Materials.
 - 9. Fill Under Slabs-on-Grade Pads.

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete.
 - 2. Section 31 22 13 - Rough Grading: Site filling.
 - 3. Section 31 23 16 - Excavation.
 - 4. Section 31 23 17 - Trenching: Backfilling of utility trenches.
 - 5. Section 32 12 16 - Asphaltic Concrete Paving.
 - 6. Section 32 13 13 - Portland Cement Concrete Paving.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

- C. Michigan Department of Transportation (MDOT)
 - 1. MDOT Standard Specification for Construction, current edition.
 - 2. MDOT Density Control Handbook, current edition.

- D. ANSI/ASTM
 - 1. ANSI/ASTM C136 or MTM 108 & 109 - Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ANSI/ASTM C117 or MTM 108 - Test method for materials finer than 15mm (No. 200 Sieve) in mineral aggregates by washing.

1.3 SUBMITTALS

- A. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- B. Samples: Submit, in air-tight containers, 10 lb. sample of each type of fill to testing laboratory.
- C. Materials Source: Submit name of imported fill materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with MDOT Standard Specifications for Construction, current edition.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Type A - Coarse Stone Fill: MDOT 6A -Compacted crushed limestone, 100% crushed - for wet excavation, excavation within open drain, backfill for subgrade undercutting for poor soil or in pipe trench, compacted to a minimum of 95 percent of the materials maximum dry density, in layers not to exceed 12 inches loose depth, unless otherwise specified. A ballast type crushed limestone free of shale, clay, friable material, sand, and debris graded in accordance with ANSI/ASTM C136.
- B. Type B - Granular Fill and Subbase: MDOT Class II - for dry excavation, pipe bedding to 12” above pipe, and trench backfill within roadway influence or dry excavation. Compacted to a minimum of 95 percent of the materials maximum dry density as determined by Michigan one-point cone method in layers not to exceed 12 inches loose depth. Substitute with Type A MDOT 6A coarse stone for wet excavation. Use MDOT Class III A: Conforming to State of Michigan Department of Transportation standard specification for construction (used for sanitary sewer backfill – 1’ over top of pipe only).
- C. Type C - Structural Fill: MDOT Class I - for lower area of excess excavation over 24", compacted to a minimum of 95 percent of the materials maximum dry density as determined by Michigan one-point cone method in layers not to exceed 12 inches loose depth.
- D. Type D - Native Subsoil: Site soils reused, free of gravel larger than 3-inch size, organic material, and debris, backfill above bedding of pipe to subgrade in greenbelt area. Compacted to a minimum of 90 percent of the materials maximum dry density, in layers not to exceed 12 inches loose depth, unless otherwise specified or as approved by the Engineer.

- E. Type E - Dense Aggregate: MDOT 22A for base course under Hot Mix Asphalt surfaces and Class I shoulders and approaches, compacted to 98% of the maximum unit weight at no greater than optimum moisture content. MDOT 23A for Class II shoulders and approaches, and temporary and permanent gravel surfaces, compacted to 95% of the maximum unit weight at no greater than optimum moisture content, compacted in layers not to exceed 12 inches loose depth.
- F. Type F – MDOT Standard Flowable Fill (Fill Class C concrete) – for headwall, sheet piling repair, and culvert storm sewer backfilling.
- G. Type H - Granular Embankment: MDOT Class I, Class II, or Class III – for granular embankment construction, compacted to a minimum of 95% of its maximum dry density as determined by the Michigan one-point cone method in layers not to exceed 12 inches loose depth. The Contractor shall provide samples of the proposed sand embankment material to the Geotechnical Engineer for visual examination and possible laboratory testing/analysis to confirm the material meets the specified material type. Approved material shall be excavated from the borrow area free from frozen soil, organics, or other deleterious materials.

2.2 ACCESSORIES

- A. Filter Fabric: Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.
- B. Verify subdrainage, damp proofing, or waterproofing installation has been inspected.
- C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.
- D. Verify structural ability of unsupported walls to support loads imposed by fill.
- E. Verify that all fill materials to be used are acceptable.
- F. Verify foundation and/or perimeter drainage installation has been inspected.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
 - 1. In areas that are suspect and may require subgrade undercutting, notify Engineer immediately. Do not proceed until it is agreed subgrade undercutting is required and quantities can be documented. See Section 31 23 16 - Excavation.
- C. Scarify subgrade surface to depth of 6 inch.

- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.
 - 1. Thoroughly proof-roll all areas of building pads, slabs-on-grade, bituminous pavement, concrete curb and gutter and sidewalks with a fully loaded tandem-axle truck, or its equivalent.
 - 2. Loose or soft areas revealed during the proof-rolling operations are to be compacted or removed and replaced according to See Section 31 23 16 - Excavation.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place geotextile fabric over Type A fill prior to placing next lift of fill.
- D. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 12 inches compacted depth.
 - 2. Structural Fill: Maximum 8 inches compacted depth.
 - 3. Granular Fill: Maximum 8 inches compacted depth.
- E. Employ placement method that does not disturb or damage other Work or foundation perimeter drainage conduit in trenches.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
- H. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- I. Make gradual grade changes. Blend slope into level areas.
- J. Remove surplus backfill materials from site.
- K. Leave fill material stockpile areas free of excess fill materials.
- L. Type B – Granular Fill: Place and compact materials as specified in Part 2 of this Section.
- M. Type D – Native Subsoil: Place on compact materials as specified in Part 2 of this Section.
- N. Machine compact under springline of pipe with T-bar or Engineer approved equivalent.
- O. Backfill simultaneously on all side of utility structures, manholes, and catch basins.
- P. Backfill wet excavation and subgrade undercutting according to Section 31 23 16 - Excavation.
- Q. Backfill subgrade undercutting in open drain according to See Section 31 23 16 - Excavation.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Within Building Areas: Plus or minus 1 inch from required elevations.
- C. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.10-foot, inch from required elevations.
- D. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with AASHTO T180.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556 or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- E. Tests and analysis of fill material will be performed in accordance with One Point Michigan Cone Test.
- F. Compaction testing will be performed in accordance with MDOT standard requirements.
- G. Frequency of tests: At the discretion of the Engineer.
- H. Proof roll compacted fill surfaces under slabs-on-grade.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished Work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 25 00

SOIL EROSION PREVENTION AND SEDIMENTATION CONTROL

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. System Description.
- B. Quality Assurance.
- C. Regulatory Requirements.
- D. Method of Payment.

1.2 SYSTEM DESCRIPTION

- A. Methods of control are identified on Drawings by numbers corresponding to the Michigan Unified Keying System for soil erosion and sedimentation control.
- B. The notation "T" or "P" following the number (as shown on the Drawings) indicates whether the control measure is temporary or permanent.
- C. Additional control measures shall be employed as required by site conditions and applicable enforcing agency having project jurisdiction.

1.3 QUALITY ASSURANCE

- A. Perform and maintain work in accordance with the Soil Erosion and Sedimentation Control, Part 91 of Act 451 of 1994, and corresponding rules of the Michigan Department of Environmental Quality.

1.4 REGULATORY REQUIREMENTS

- A. CONTRACTOR shall obtain all permits and pay all fees for plan review and inspection as required by applicable enforcing agency having jurisdiction.
- B. Submit installation time schedule for temporary and permanent soil erosion and sedimentation control measures to applicable enforcing agency having jurisdiction, as well as to Engineer. Make submittals prior to start of construction
- C. CONTRACTOR shall have a Certified Storm Water Operator onsite to review soil erosion prevention and sediment control measures and provide required documentation to enforcing agency having jurisdiction.

2. PART 2 PRODUCTS

2.1 MATERIALS

- A. Permanent Measures: In accordance with applicable Section for specified materials.

- B. Temporary Measures: In accordance with standards and specifications for soil erosion and sediment control with approved plans and requirements of applicable enforcing agency.

3. PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Field locate known utility locations. Notify Engineer of conflicts and attain removal or relocation instructions prior to continuing installation activities.
- C. Maintain and protect existing utilities to remain.

3.2 PROTECTION OF ADJACENT WORK

- A. Protect adjacent structures and property which may be damaged by execution of work.
- B. Protect existing trees, shrubs, landscaping and lawn areas designated to remain.

3.3 INSTALLATION AND MAINTENANCE

- A. Construct soil erosion and sedimentation control measures in accordance with approved plans and requirements of applicable enforcing agency.
- B. Schedule planned control measures with construction operations to limit the area of any disturbed land to the shortest possible period of exposure.
- C. Conduct all earth changes so as to effectively reduce accelerated soil erosion and resulting sedimentation.
- D. Remove all sediment from runoff water before it leaves the site.
- E. Inspect, maintain and repair temporary control measures until permanent control measures are implemented.
- F. Maintain permanent control measures until final acceptance by Owner.
- G. Install silt fences around all catchbasin inlets, to be removed after final inspection of the project.

END OF SECTION

SECTION 31 32 21

FILTER FABRIC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Filter Fabric for Groundwater Infiltration Applications.
 - 2. Filter Fabric for Plain Riprap Applications.
 - 3. Filter Fabric for Heavy Riprap Applications.
- B. Related Sections:
 - 1. Section 31 22 13 – Rough Grading
 - 2. Section 31 35 21 – Slope Protection and Erosion Control

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Filter Fabric:
 - 1. Basis of Measurement: Included in unit price for plain riprap, grade and bank protection, plain riprap spillway, field tile outlets, surface outlet tubes, drain crossings, plain riprap splash pad, check dams, sedimentation basins, or other Work item being accomplished, whichever applies.
 - 2. Basis of Payment: Includes material, labor, and equipment for installation according to plans, specifications, and manufacturer's instructions.

1.3 REFERENCES

- A. ASTM D-4632 - Test method for Tensile Strength and Elongation
- B. ASTM D-3786 - Test method for Mullen Burst.
- C. ASTM D-4533 - Test method for Trapezoidal Tear Strength.
- D. ASTM D-3787 - Test method for Puncture Strength.
- E. ASTM D-4751 - Test method for Apparent Opening Size.
- F. ASTM D-4491 - Test method for Coefficient of Permeability

1.4 COORDINATION

- A. Section 01 30 00 – Administrative Requirements specifies requirements for coordination.
- B. Coordinate Work of this Section with Section 31 37 00 – Riprap.

1.5 SUBMITTALS

- A. Submit shop drawings and product data for all items to be installed and/or constructed within this Section.
- B. Submit manufacturer's instructions for all product data.
- C. Submit manufacturer's certificate, which shall show actual test values obtained for the physical properties as tested for compliance with the specifications, for all product data.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Mechanically bonded, non-woven, long-chain polymeric fibers or yarns. The edges of the fabric shall be finished to prevent the outer fiber from pulling away from the fabric.
 - 1. Filter fabric for groundwater infiltration applications (french drains, trench drains, pipe joint wrap, etc.) and embankment filter fabric is to have, at minimum, the following properties:

Tensile Strength	100 lbs
Tensile Elongation (max)	100 %
Mullen Burst	210 psi
Trapezoidal Tear Strength	40 lbs
Puncture Strength	65 lbs
Apparent Opening Size (max)	70 sieve
Flow Rate	140 gal/min/ft ²

- 2. Filter fabric for plain riprap applications (riprap, riprap spillways, etc.) and concrete box culvert joints are to have, at minimum, the following properties:

Tensile Strength	155 lbs
Tensile Elongation (max)	100 %
Mullen Burst	315 psi
Trapezoidal Tear Strength	65 lbs
Puncture Strength	95 lbs
Apparent Opening Size (max)	70 sieve
Flow Rate	110 gal/min/ft

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for installation examination.
- B. Verify the correct fabric is specified for the specific use.

- C. At the time of installation, the filter fabric may be rejected at the discretion of the Engineer if it has been removed from its protective cover for over 72 hours or has defects, tears, punctures, flow deterioration, or damage incurred during manufacture, transportation or storage.
- D. No torn, punctured, or otherwise damaged fabric shall be installed.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for installation preparation.
- B. Remove large stones or other debris, which could damage the filter fabric.
- C. Adjacent Surfaces: Protect adjacent surfaces.

3.3 STORAGE

- A. During all periods of shipment and storage, the filter fabric shall be protected from abrasion, direct sunlight, ultraviolet rays, and temperatures greater than 140 degrees Fahrenheit (or as directed by the manufacturer). To the extent possible, the fabric shall be maintained wrapped in its protective covering.

3.4 INSTALLATION

- A. All joints/overlaps in material shall be a minimum of 2 feet.
- B. Any damaged material shall be repaired by placing a piece of fabric that is sufficiently large to cover the damaged area plus 2 feet of adjacent undamaged geotextile in all directions.
- C. Finish according to specific use requirements.
- D. Edges of filter fabric shall be toed in 12 inches unless specified otherwise. Work will not pass inspection if filter fabric is not "toed in."

3.5 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for protecting finished Work.
- B. Do not permit Traffic over unprotected surface.
- C. Take care placing material over filter fabric so as not to damage the material.

END OF SECTION

SECTION 33 13 00

DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes disinfection of potable water distribution and transmission system; and testing and reporting results.
- B. Related Sections:
 - 1. Section 33 11 13 – Public Water Utility Distribution Piping Product and Execution requirements for installation, testing, of public domestic water distribution piping.

1.2 BASIS OF PAYMENT

- A. Disinfection:
 - 1. Basis of Measurement: Included in the lump sum price bid for water main pipe as stated in section 33 05 23.13 Utility Horizontal Directional Boring.
 - 2. Basis of Payment: Includes all associated labor, material and equipment for cleaning and disinfecting water main required for the project for a complete installation.

1.3 REFERENCES

- A. American Water Works Association:
 - 1. AWWA B300 - Hypochlorites.
 - 2. AWWA B301 - Liquid Chlorine.
 - 3. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 4. AWWA C605 -
 - 5. AWWA C651 - Disinfecting Water Mains
 - 6. NSF – Plastic Piping System Components and Related Materials.
 - 7. NSF/ANSI Standard 61 Drinking Water System Components
 - 8. Michigan Safe Drinking Water Act 1976 PA 399, as amended.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.
- C. Test Reports: Indicate results comparative to specified requirements.
- D. Certificate: Certify cleanliness of water distribution system meets or exceeds MDEQ requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this section with minimum three years documented experience.
- B. Submit bacteriologist's signature and authority associated with testing.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, AWWA B301 and Liquid Chlorine.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping system has been cleaned, inspected, and pressure tested.
- C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

- A. All disinfectant work shall be performed in accordance with AWWA C651-14 Disinfecting Water Mains.
- B. Inject disinfectant, chlorine solution, through a corporation cock inserted in the horizontal axis of the water main.
- C. Inject at the beginning of the pipe line or a valved section.
- D. Slowly fill the line with potable water from the existing distribution line.

- E. Bleed water from a valve at the end of the line to ensure distribution and prevent pressure build up in excess of 20 psi.
- F. Inject disinfectant, chlorine solution, to obtain a minimum initial residual concentration of 40 to 50 mg/l in accordance with AWWA C651 “Continuous-Feed” method.
- G. Chlorine residual shall be checked with a proper residual test kit that can measure elevated chlorine residuals.
- H. Flush disinfectant from pipe line. Contractor shall employ dechlorination methods before discharging into storm sewer, open drains, or over land. Dechlorinate flushing water in accordance with AWWA C655-09 Filed Dechlorination.
- I. Flushing shall continue until the chlorine residual in the disinfected main is absent or no higher than is normally found in the distribution system.
- J. Repeat the complete disinfection process if laboratory results deem the water unsafe for drinking.
- K. Replace corporation cocks with brass plugs when the disinfection process is complete and water is determined safe for drinking.
- L. The use of chlorine pills or tables placed in the pipe during construction to be used in the disinfection process is prohibited.
- M. Do not place water mains into service until all the requirements of AWWA C651-14 disinfecting water mains are met.
- N. Sampling: Sets of samples shall be collected approximately every 1200 feet of water main, plus one set from the end of the line and at least one from each branch greater than one pipe length.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Disinfection, Flushing, and Sampling:
 1. Disinfect pipeline installation in accordance with AWWA C651. In addition, the use of chlorine pills or tables placed during construction will not be permitted.
 2. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
 3. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.

3.4 WATER COST

- A. The Contractor shall pay all water used during construction, including water main breaks and water necessary for testing, cleaning, and chlorinating water mains.

- B. The actual volume of water used shall be determined by the Engineer.
- C. The rate of pay for all water used shall be at the current rate per 1,000 gallons.
- D. The water necessary to fill the volume of the water main at the completion of the project shall be paid by the Owner.

END OF SECTION

SECTION 33 31 00

SANITARY SEWERAGE SYSTEM

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary sewer service.

1.2 RELATED SECTIONS

- A. Section 31 23 17 - Trenching,
- B. Section 31 05 16 - Aggregate for Earthwork:

1.3 REFERENCES

- A. ANSI/ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- B. ANSI/ASTM D2729 - Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- C. ANSI/ASTM D3033 - Type PSP Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- D. ANSI/ASTM D3034 - Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- E. ASTM D1785 – Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- F. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- G. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.4 PART DEFINITIONS

- A. Bedding: Fill placed under, beside and 12" directly over pipe, prior to subsequent backfill operations.

1.5 PROJECT RECORD DOCUMENTS

- A. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this section.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements and elevations are as indicated.

1.8 COORDINATION

- A. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

2. PART 2 PRODUCTS

2.1 SEWER PIPE MATERIALS

- A. Plastic Pipe: ANSI/ASTM D3034, SDR 35, Type PSM, (PolyVinyl Chloride) (PVC) material; inside nominal diameter of 6, 8, 10 and 12 inches, rubber gasket joints. (Sewers 19' deep or less.) Joints shall meet ASTM D3212.

2.2 BEDDING MATERIALS

- A. P.V.C. Pipe: See drawings.

2.3 MANHOLE STRUCTURES AND ACCESSORIES

- A. Barrel and conical top section.
 1. Reinforced, precast concrete pipe section conforming to ASTM C478.
 2. Nominal diameter of 48 inches or as indicated on the drawings.
 3. Pre-cast reinforced concrete base.
 4. Plastic coated steel steps at 15 inches on center.
 5. O-ring rubber gasket premium type joints.
 6. 1/2 inch diameter galvanized pipe nipple with cap through the manhole wall at an elevation equal to the top of the pipe. Nipple shall extend 3 inches into the manhole.
 7. Connect main line and branches to manholes utilizing a flexible neoprene gasket with stainless steel band.
 - a. Kor-N-Seal, by National Pollution Control Systems, Inc.
 - b. Model Ps10, by Press Seal Gasket Corp.
 - c. A-Lok, by A-Lok Products, Inc.
 - d. Or equal.

2.4 MANHOLE STRUCTURE CASTINGS

- A. As indicated on the plans.

- B. Or equal.
- C. Manhole frame shall have 4 holes in the base flange for bolting to cone section.
- D. Furnish 4 inch by 5/8 inch cadmium coated threaded studs with nuts and washers for bolting frame to cone section.
- E. Manholes shall be adjusted to grade using grade rings with rubber gaskets.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with Type A (MDOT 6A) fill coarse aggregate.
- B. Remove large stones or other hard matter, which could damage pipe or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17 - Trenching for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Dig out for pipe bells.
- C. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION SERVICE RELOCATIONS

- A. Install pipe, fittings, and accessories in accordance with ASTM C12 - ASTM D2321 and manufacturer's instructions. Seal joints watertight.
- B. Install bedding at sides and over top of pipe to minimum compacted thickness of 12 inches compacted to 95 percent.

- C. Refer to Section 31 23 17 - Trenching for trenching requirements. Do not displace or damage pipe when compacting.
- D. Install at locations indicated on the drawings.
- E. Verify inverts of proposed services.
- F. Minimum grade for service shall be 1.0 ft. per 100 ft.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of contract.
- B. Request inspection prior to and immediately after placing bedding.
- C. Compaction testing will be performed in accordance with MDOT standard requirements.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- E. Frequency of Tests: As directed by the Engineer.

3.6 PROTECTION.

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 41 00

STORM SEWERAGE SYSTEMS

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Storm sewerage drainage piping, fittings, and accessories, and bedding.
- B. Connection of storm water drainage system to existing storm sewerage drainage.
- C. Catch basins, manholes, and paved areas drainage

1.2 RELATED SECTIONS

- A. Section 31 23 16 – Excavating.
- B. Section 31 05 16 – Aggregate for Earthwork.

1.3 REFERENCES

- A. ASTM D-3350 – Polyethylene Plastics Pipe and Fittings.
- B. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- C. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- D. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- E. ANSI/ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- F. ANSI/ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) Fittings.
- G. ANSI/ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

ANSI/ASTM D2729 - Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

- H. ANSI/ASTM D3034 - Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe Fittings.
- I. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) PVC Plastic Pipe Schedules 40, 80, and 120.

- J. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- K. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
- L. ASTM C507 – 10 Standard Specifications for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
- M. MDOT Standard Specifications for Construction – Current Edition.
- N. Corrugated Metal Pipe – size, corrugation, and gate as indicated on plans, or MDOT Class B or equal.

1.4 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.5 SUBMITTALS

- A. Product Data: Provide data indicating pipe, pipe accessories, and sock.
- B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this Section.
- B. Conform to applicable standards for pipe and fitting identification markings.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements and elevations are as indicated.

2. PART 2 PRODUCTS

2.1 SEWER PIPE MATERIALS

- A. Pipe Material as indicated on plan.

2.2 PIPE ACCESSORIES

- A. Fittings: Same material as pipe, molded and formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. Couplings: Flexible, elastomeric plastic sleeve with stainless steel clamps and bands, for connecting proposed and existing services. As manufactured by Fernco Joint Sealer Co. or equal.
- C. Plugs: Furnished by the pipe manufacturer for the specific use with that pipe as approved by the Engineer.
- D. Branch Connections:
 - 1. Size and character as indicated on the drawings.
 - 2. Connection shall be an integral part of the main sewer pipe with a shoulder made to receive the hub of the branch pipe indicated.

2.3 DRAINAGE STRUCTURES AND ACCESSORIES

- A. Barrel and conical top and flat top sections. (Nominal Diameters of 3' to 6')
 - 1. Reinforced, precast concrete pipe section conforming to ASTM C-478.
 - 2. Nominal diameter as indicated on the drawings.
 - 3. Precast reinforced concrete base as indicated on drawing and approved by Engineer.
 - 4. Tongue and groove joints sealed with bitumastic joint compound.

2.4 DRAINAGE STRUCTURE CASTINGS

- A. Drainage Structures – Castings as indicated on Drawings.
- B. Adjustment in elevation:
 - 1. Adjust the cover to the required elevation by supporting it on one of the following:
 - a. A metal ring adjustor
 - b. A concrete collar
 - c. Masonry in a full mortar bed
 - d. An alternate adjustor selected from the MDOT Qualified Product List
 - 2. Hold adjusted covers firmly in place. Remove and replace the adjacent pavement, curb, or curb and gutter to match the existing grades or to the required elevations.

- C. Laying Brick:
1. All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid.
 2. All brick shall be laid in freshly made mortar.
 3. Mortar that is not used within 45 minutes after water has been added shall be discarded.
 4. Retempering of mortar shall not be permitted.
 5. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it which can be readily closed by the laying of the brick.
 6. All bed and head joints shall be filled solid with mortar.
 7. Any bricks that may be loosened after the mortar has taken its set, shall be removed, cleaned and relaid with fresh mortar.
- B. Joints:
1. All joints shall be slushed with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint.
 2. Exterior and interior faces shall be back plastered with a coat of mortar not less than 3/8 inch thick.
 3. Unless otherwise noted, joints shall be not less than 1/4 inch nor more than 1/2 inch wide.
- C. Pointing:
1. Face joints shall be neatly stuck, using the weather joint.
 2. All joints shall be finished properly as the laying of the brick progresses.
- D. Placement of Casting:
1. All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the Engineer, and shall be set true to line and to correct elevation.
 2. Frames or fittings are to be set in cement mortar, as specified in MDOT Standard Specification 7.02.
 3. The unit shall not be disturbed until the mortar has set.
 4. When frames or fittings are to be placed upon previously constructed masonry, the bearing surface or masonry shall be brought true to line and grade and shall present an even bearing surface in order that the entire face or back of the unit will come in contact with the masonry.
 5. The top of the structure shall be cleaned thoroughly and the surface wetted.
 6. The height of the structure shall be adjusted so that a minimum of 1/2 inch of mortar can be spread evenly over the surface of the structure and the curb casting set at the proper elevation without any voids under the casting.
 7. When the casting has been set it shall not extend out over the edge of the catch basin structure.
 8. A fabric wrap shall then be placed around the catch basin casting even with the height of the gutter pan and extending down and over the outside of the catch basin structure to a sufficient depth so as to exclude the possibility of any sand or gravel from washing under the curb casting.

9. Once the casting has been set to the proper grade on a fresh bed of mortar, the curb may be poured up to the curb casting.

1.2 FILL MATERIAL

- A. Schedule of Bedding Materials:
 1. All bedding is to be compacted to 95% of its maximum density – see drawings for bedding type.
- B. Cover Materials:
 1. The sides of all pipe shall be backfilled with MDOT Class II A fill to 12” above the pipe. Compact in 12” lifts to 95% of its maximum density unless otherwise indicated on the plans.
 2. All areas to be landscaped seeded shall be backfilled with native material compacted to 95% from 12” above the top of pipe. All other areas are to complete sand backfill, or as indicated on plans.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with fill material specified in Section 31 05 16 – Aggregate for Earthwork and 312316 – Excavation.
- B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.
- C. Cut out soft areas of subgrade not capable of insitu compaction. Backfill with MDOT 6A stone and compact to density equal to or greater than requirements for support of pipe or structure and subsequent backfill material.
- D. Excavate pipe trench in accordance with Section 31 23 16 – Excavation for work of this section. Hand trim excavation for accurate placement of pipe to elevations indicated allowing for bedding thickness.

3.3 BEDDING

- A. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth.

- B. Maintain optimum moisture content of bedding material to attain required compaction density.
- C. Dig out for pipe bells.

3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with ASTM Standards, MDOT and manufacturer's instructions.
- B. Place pipe on specified bedding.
- C. Lay pipe to slope gradients noted on layout drawings by the use of a laser beam alignment method proven reliable and operated by competent, experienced personnel.
- D. Place remainder of bedding as specified. Do not displace or damage pipe when compacting.
- E. Install and compact backfill according to Section 31 05 16 – Aggregate for Earthwork. Do not displace or damage pipe when compacting.
- F. Contractor shall use appropriate measures, approved by the Engineer to provide a sealed connection between the storm sewer and appurtenances.

3.5 CONNECTION TO EXISTING DRAINAGE STRUCTURES

- A. Cut a minimum opening equal to the outside diameter of the inlet pipe plus 6 inches into the receiving structure.
- B. Pack a minimum 3-inch mortar layer completely around the inlet pipe and strike smooth with the inner wall of the structure.
- C. Repair or replace any existing drainage structure damaged during the tapping operation.

3.5 INSTALLATION – DRAINAGE STRUCTURES AND CLEANOUTS

- A. Install according to manufacturer's instructions.
- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Place precast concrete base pad, tee sections, and sections with integral bottoms on 6 inches of Type D (MDOT 6A) compacted stone bedding;
- D. Level top surface of base pad or tee section to receive concrete shaft sections.
- E. Establish elevations and pipe inverts for inlets and outlets as indicated.

- F. Mount lid and frame level in grout, secured to top cone section or flat top to elevation indicated.
- G. Grout all joints between base pad, pipe connections, and top.
- H. Install barrel sections, cone section, and frame and cover to elevation indicated.
- I. Maximum height from top of cone to bottom of frame shall be 12 inches.
- J. Install stubs and branch connections at locations and elevations. Close ends with approved plug.
- K. Bed stubs and branch connections as indicated on the plans.

3.6 REMOVAL - EXISTING CATCHBASINS AND MANHOLES

- A. Remove existing structures complete at the locations indicated on the drawings.
- B. Maintain continuous service in live lines.
- C. Reconnect lines scheduled to remain in service, as indicated on the drawings.

3.7 INSTALLATION - BRANCH CONNECTIONS

- A. Install according to manufacturer's directions.
- B. Install at the locations indicated on the drawings.
- C. Bed branch pipes within the limits of the main pipe trench on MDOT 6AA stone to the spring line of the pipe with a width 6 inches on either side of the pipe greater than the outside diameter of the branch pipe.
- D. Install a short section of the branch pipe in the shoulder provided in the main pipe and grout in place.
- E. Branch pipe shall not extend past the inside face of the receiving main pipe.
- F. Provide a bell end on the branch pipe to receive the spigot end of the adjoining section of branch pipe.
- G. Seal ends of branch pipe not immediately extended with a plug provided by the pipe manufacturer and approved by the Engineer.
- H. Mark the plugged ends of branch pipes with a 2-inch by 6-inch x 6-foot post extended to 12 inches below grade.

3.8 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under contract provisions.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.9 PROTECTION

- A. Protect finished work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION