PROJECT: WESTERN TECHNICAL COLLEGE
APPRENTICESHIP CENTER REMODEL
2860 21ST PLACE SOUTH
LA CROSSE, WISCONSIN 54601
HSR PROJECT NO. 19021

OWNER: WESTERN TECHNICAL COLLEGE
PHYSICAL PLANT OFFICE
505 9TH STREET NORTH
LA CROSSE, WISCONSIN 54601
ATT: JAY McHENRY – DIRECTOR OF FACILITIES

ARCHITECT/ENGINEER (AE): HSR ASSOCIATES, INC.
ARCHITECTURE/ENGINEERING
100 MILWAUKEE STREET
LA CROSSE, WISCONSIN 54603
Telephone: (608) 784-1830

Project Manager: Doug Ramsey
Architecture: Michelle Maland
Interiors: Kylie Veerkamp
Mechanical: Jake Beran
Specifications: Ron Knapmiller

AE CONSULTANTS:
ELECTRICAL / PLUMBING:
GALILEO CONSULTING GROUP
2920 East Ave S, Suite 102
La Crosse, WI 54601
Pat Popowich (Electrical)
Chris Olson (Plumbing)
(608) 787-9106
ppopowich@galileo-group.us
colson@galileo-group.us

STRUCTURAL:
RA SMITH
5250 East Terrace Drive, Suite 108
Madison, WI 53718
Wayne Vandenbergh
(608) 421-5316
wayne.vandenbergh@rasmith.com

CIVIL:
POINT OF BEGINNING
5709 Windy Drive, Suite D
Stevens Point, WI 54482
Dan St. Pierre
(715) 344-9999
dans@pobinc.com

HSR PROJECT NO: 19021
DATE OF PROJECT MANUAL: February 2020

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END OF DOCUMENT 00 01 10
Sealed bids for the construction of:

WESTERN TECHNICAL COLLEGE
APPRENTICESHIP CENTER REMODEL
2860 21ST PLACE SOUTH
LA CROSSE, WISCONSIN 54601
HSR PROJECT NO. 19021

will be received by: 西部技术学院
物理设施办公室
505 9TH STREET NORTH
LA CROSSE, WISCONSIN 54601
ATT: JAY McHENRY – DIRECTOR OF FACILITIES

until 2:00 PM, March 3, 2020, after which they will be opened publicly and read aloud. Bids received after the time set for receipt of bids will not be accepted.

Along with the Base Bid the project will be separated into three additional alternates. Refer to Section 01 23 00 for Alternate descriptions. All Work will be awarded to the single low bidder of base bid and all alternates.

Base Bid Interior Renovations: Project consists of remodeling of approximately 18,600 s.f. of space of the existing building. Work includes, but is not limited to interior demolition, interior aluminum storefront, casework, new flooring, painting, new wall coverings, new ceiling panels and linear metal ceilings, carpet, fire protection revisions, interior wood trusses, shingles, precast plank, plumbing fixtures and systems, electrical equipment for lab spaces and required power, lighting and data revisions; and coordination with owner’s furniture vendor.

Parking Lot & Site work: Reconstruction of the parking lot, site lighting, infilling existing loading dock, storm water retention and plantings.

HVAC: Installation of new roof top unit and modification of existing system.

Exterior Renovation & Addition: Exterior wall renovation including the new tower vestibule addition. Removal of a portions of exterior wall, structural steel for wall support, new windows and doors, paint, brick and rain screen metal panel system.

Lump-sum Bids will be received on a SINGLE PRIME CONSTRUCTION CONTRACT FOR THE ENTIRE WORK including plumbing, mechanical and electrical work.

The Project Drawings, Project Manual and other Bidding Documents prepared by the AE may be examined at the following locations:

AE’s Office:  HSR ASSOCIATES, INC.
100 Milwaukee Street
La Crosse, WI 54603
608-784-1830

Builder’s Exchanges:  La Crosse, WI
Northwest Regional (Eau Claire/Chippewa Falls)
Wausau, WI
Builders Exchange of Wisconsin (Appleton)
Minneapolis, MN
Rochester, MN
ConstructConnect
Bidding Document PDF files will be available from HSR Associates, Inc. via Sharefile electronic distribution. Access will be given upon request. Documents will be available from listed Builders Exchanges as well. Addendums will be distributed via the Sharefile system. OR

Bidders may request printed Bidding Documents at the office of the AE by sending a check made out to HSR Associates in the amount of $15.00, as a fee to cover the cost of postage and handling. Such fee amount will not be refunded. Postage fee must be received before documents are shipped.

Disclaimer: HSR Associates is responsible for distribution of addenda to only those that have requested project documents from HSR in formats described above.

Note that HSR Associates offers a printing service of documents including single sheets or entire document. Contact HSR for rates.

REQUESTED CAD FILES: Upon award of Contract Autocad files will be made available from HSR upon request.

A plan holders list is available on HSR’s website; www.hsrassociates.com. List is only of those requesting plans from HSR. If you obtained plans from another source and want your firm on HSR’s list contact us.

BID SECURITY in the amount of five percent of the maximum amount of the Bid must accompany each Bid as described in the Instructions to Bidders in the Project Manual.

The Owner reserves the right to waive irregularities and to reject any or all Bids. No Bid may be withdrawn until 30 days after the time stated for receipt of Bids.

A pre-bid meeting will be conducted by the Owner and Architect/Engineer to answer questions and to enable bidders to examine conditions at the Project Site. Such meeting will occur at 10:00 a.m. February 18, 2020. Meet at south entrance of existing building.

By: Jay McHenry
Title: Director of Facilities

Publish Date: Week of February 10 and 17, La Crosse Tribune.

END OF DOCUMENT 00 11 13
INSTRUCTIONS TO BIDDERS

The Instructions to Bidders, AIA Document A701, 2018 Edition, is hereby made a part of this Project Manual, except as amended or supplemented by Document 00 22 13 - Supplementary Instructions to Bidders.

A copy of the above AIA Instructions to Bidders is included with this Project Manual.

Amendments and supplements to these instructions are described in Document 00 22 13.

END OF DOCUMENT 00 21 13
Instructions to Bidders

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

THE OWNER:
(Name, legal status, address, and other information)

THE ARCHITECT:
(Name, legal status, address, and other information)

TABLE OF ARTICLES
1 DEFINITIONS
2 BIDDER’S REPRESENTATIONS
3 BIDDING DOCUMENTS
4 BIDDING PROCEDURES
5 CONSIDERATION OF BIDS
6 POST-BID INFORMATION
7 PERFORMANCE BOND AND PAYMENT BOND
8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

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

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G512™–2017, Owner’s Instructions to the Architect, Parts A and B will be completed prior to using this document.
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 any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement’s Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents apply to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect, which, by additions, deletions, clarifications, or corrections, modify or interpret the Bidding Documents.

§ 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, to which Work may be added or deleted by 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, or that does not change, 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 By submitting a Bid, the Bidder represents that:
.1 the Bidder has read and understands the Bidding Documents;
.2 the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid concurrently or presently under construction;
.3 the Bid complies with the Bidding Documents;
.4 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 observations with the requirements of the Proposed Contract Documents;
.5 the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
.6 the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

ARTICLE 3  BIDDING DOCUMENTS
§ 3.1 Distribution
§ 3.1.1 Bidders shall obtain complete Bidding Documents, as indicated below, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.
(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall obtain Bidding Documents.)
§ 3.1.2 Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding Documents, and the Bidder’s deposit will be refunded.

§ 3.1.3 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.

§ 3.1.4 Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

§ 3.1.5 The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

§ 3.2 Modification or Interpretation of Bidding Documents
§ 3.2.1 The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

§ 3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least seven days prior to the date for receipt of Bids. (Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall submit requests for clarification and interpretation.)

§ 3.2.3 Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall 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 Substitution Process
§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

§ 3.3.2.2 Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

§ 3.3.2.3 If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

§ 3.3.3 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.

§ 3.3.4 If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.
§ 3.3.5 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 Bidders known by the issuing office to have received complete Bidding Documents. (Indicate how, such as by email, website, host site/platform, paper copy, or other method Addenda will be transmitted.)

§ 3.4.2 Addenda will be available where Bidding Documents are on file.

§ 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 Prior to submitting a Bid, each Bidder shall ascertain 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 or identified in the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed. Paper bid forms shall be executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms 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” or as required by the bid form.

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder’s refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name 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.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

§ 4.2 Bid Security
§ 4.2.1 Each Bid shall be accompanied by the following bid security: (Insert the form and amount of bid security.)
§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond, unless otherwise provided in the Bidding Documents. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or if a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning ______ days after the opening of Bids, withdraw its Bid and request the return of its bid security.

§ 4.3 Submission of Bids
§ 4.3.1 A Bidder shall submit its Bid as indicated below:
(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

§ 4.3.2 Paper copies of the Bid, the bid security, 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.

§ 4.3.3 Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

§ 4.3.4 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.5 A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

§ 4.4 Modification or Withdrawal of Bid
§ 4.4.1 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

§ 4.4.2 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

§ 4.4.3 After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted. If a Bid is withdrawn pursuant to this Section 4.4.3, the bid security will be attended to as follows:
(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)
ARTICLE 5   CONSIDERATION OF BIDS
§ 5.1 Opening of Bids
If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be publicly opened and read aloud. A summary of the Bids may be made available to Bidders.

§ 5.2 Rejection of Bids
Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

§ 5.3 Acceptance of Bid (Award)
§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. Unless otherwise prohibited by law, 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 best interests.

§ 5.3.2 Unless otherwise prohibited by law, 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 lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6   POST-BID INFORMATION
§ 6.1 Contractor’s Qualification Statement
Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request and within the timeframe specified by the Architect, a properly executed AIA Document A305™, Contractor’s Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

§ 6.2 Owner’s Financial Capability
A Bidder to whom award of a Contract is under consideration may request in writing, fourteen days prior to the expiration of the time for withdrawal of Bids, that the Owner furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner’s obligations under the Contract. The Owner shall then furnish such reasonable evidence to the Bidder no later than seven days prior to the expiration of the time for withdrawal of Bids. Unless such reasonable evidence is furnished within the allotted time, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 Submittals
§ 6.3.1 After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:
.1 a designation of the Work to be performed with the Bidder’s own forces;
.2 names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; 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 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, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for 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.

§ 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 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.
(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

§ 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 commence sooner 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.

§ 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 to the bond a certified and current copy of the power of attorney.

ARTICLE 8  ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS
§ 8.1 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013.)
.5 Drawings

Number  Title  Date

.6 Specifications

Section  Title  Date  Pages

.7 Addenda:

Number  Date  Pages

.8 Other Exhibits:

☐ AIA Document E204\textsuperscript{TM}–2017, Sustainable Projects Exhibit, dated as indicated below:

(Insert the date of the E204-2017.)

☐ The Sustainability Plan:

Title  Date  Pages

☐ Supplementary and other Conditions of the Contract:

Document  Title  Date  Pages

.9 Other documents listed below:

(List here any additional documents that are intended to form part of the Proposed Contract Documents.)
SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The following Supplementary Instructions to Bidders modify, change, delete from or add to the “AIA Instructions to Bidders”. Where any Article of the AIA Instructions to Bidders is modified or any Paragraph, Subparagraph or Clause thereof is modified or deleted by these Supplementary Instructions to Bidders, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

ARTICLE 1 – DEFINITIONS

Add the following Paragraph:

1.10 “PROJECT” as used in these documents shall mean:
WESTERN TECHNICAL COLLEGE
APPRENTICESHIP CENTER REMODEL
2860 21ST PLACE SOUTH
LA CROSSE, WISCONSIN 54601
HSR PROJECT NO. 19021

1.11 The term “OWNER” as used on these documents shall mean:
WESTERN TECHNICAL COLLEGE
PHYSICAL PLANT OFFICE
505 9TH STREET NORTH
LA CROSSE, WISCONSIN 54601
ATT: JAY McHENRY – DIRECTOR OF FACILITIES

1.12 “ARCHITECT/ENGINEER” and “AE” as used in these documents shall mean:
HSR ASSOCIATES, INC.
100 MILWAUKEE STREET
LA CROSSE, WISCONSIN  54603
Telephone: (608) 784-1830
Fax: (608) 782-5844

and AE’s Consultants, as follows:

AE CONSULTANTS:
ELECTRICAL / PLUMBING:
GALILEO CONSULTING GROUP
2920 East Ave S, Suite 102
La Crosse, WI 54601
Pat Popowich (Electrical)
Chris Olson (Plumbing)
(608) 787-9106
ppopowich@galileo-group.us
colson@galileo-group.us

STRUCTURAL:
RA SMITH
5250 East Terrace Drive, Suite 108
Madison, WI 53718
Wayne Vandenberg
(608) 421-5316
wayne.vandenberg@rasmith.com

CIVIL:
POINT OF BEGINNING
5709 Windy Drive, Suite D
Stevens Point, WI 54482
Dan St. Pierre
(715) 344-9999
dans@pobinc.com
ARTICLE 2 – BIDDER’S REPRESENTATIONS: No Changes.

ARTICLE 3 – BIDDING DOCUMENTS

In Subparagraph 3.1.1, delete the sentence, “The deposit will be refunded to Bidders who submit a bonafide Bid and return the bidding documents in good condition within 10 days after receipt of bids,” and insert in its place the sentence, “The deposit will be returned in full for each set returned in good condition within 10 days after bid opening.”

Delete Subparagraph 3.1.2 in its entirety.

In Subparagraph 3.3.2., delete the first sentence and insert in its place, “No substitution will be considered unless: Written request for approval has been submitted by the Bidder and has been received by the AE at least 10 days prior to the date for receipt of bids.”

Revise Subparagraph 3.3.3 to read as follows:

“3.3.3 If the AE approves any proposed substitutions during the bidding period, such approval will be set forth in an addendum.

.1 Proposed substitutions must be described in detail and supported by substantiating specifications and other data. Identify proposed substitutions by reference to the specific Project Specification section and paragraph related to the substitution. Provide any additional information required by the AE necessary to determine conformity to specified requirements.

.2 Under no circumstances will the AE be required to prove that an item proposed for substitution is not equal to the specified item. The decision of the AE on all requests for substitutions is final.

.3 The AE will reject any materials and workmanship, either before or after installation is complete, which is substituted and has not been approved by the AE in writing.

.4 Bidders shall not rely upon approvals made in any other manner.”

3.3.4 Add: “Bidder’s Choice Substitution: Contractor may provide a price for a substitute product or process that he/she feels is comparable to that specified. These substitutions may be reviewed by the Architect on behalf of the Owner after the low bid has been accepted, but this application does not imply any obligation on the part of the Architect to review or accept any Bidder’s Choice Substitution. Contractor may copy the Bidder’s Choice Substitution portion of the Bid Form for multiple entries.”

ARTICLE 4 – BIDDING PROCEDURES

4.1. FORM AND STYLE OF BIDS

Add subparagraph, as follows:

4.1.8 Each Bid must be accompanied by the following:

.1 BID SECURITY.

.2 A completed 00 45 13 CERTIFICATE OF ORGANIZATION AND AUTHORITY form properly notarized.

.3 A completed 00 45 17 NON-COLLUSIVE AFFIDAVIT form properly notarized.

.4 A completed 00 45 19 CERTIFICATION OF NON-SEGREGATED FACILITIES form.

4.2 BID SECURITY

In Subparagraph 4.2.1, delete the last sentence and insert in its place, “Should the Bidder refuse to enter into such contract or fail to furnish assurance of faithful performance of the contract and the payment of all obligations arising thereunder in the form of a performance bond in the amount of 100 percent of the contract price and payment bond in the amount of 100 percent of the contract price, the amount of bid security shall be forfeited to the Owner as liquidated damages, not as penalty.”
Revise wording of Subparagraph 4.2.2 to the following:

“4.2.2. Make Bid Security payable to the Owner in an amount not less than Five Percent (5%) of the maximum amount of the Bid. Bid Security shall be either a certified check or AIA Document A310, Bid Bond issued by a surety licensed to conduct business in the State of Wisconsin and listed currently in Circular 570 issued by the U.S. Treasury Department. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of his power of attorney.”

**ARTICLE 5 – CONSIDERATION OF BIDS**

After 5.3.2 add the following:

“5.3.2.1 Low Bidder shall be determined by adding Base Bid and all alternates.”

**ARTICLE 6 – POST-BID INFORMATION: No Changes.**

**ARTICLE 7 – PERFORMANCE BOND AND PAYMENT BOND**

Omit Subparagraphs 7.1.2 and 7.1.3 in their entirety and substitute the following:

“7.1.2 The Contractor shall furnish bonds as described below, covering the faithful performance of the Contract and the payments of all obligations arising thereunder. The bonds specified under this Article shall be issued by a bonding company licensed to do business in the state where the construction will take place.

7.1.3 Furnish both AIA A312 Performance Bond and AIA A312 Payment bond, each in the amount of 100% of the contract price.

7.1.4 Bond amounts shall not exceed the single bond limit for the Contractor's bonding company as set forth in the Federal Register current as of the date."

7.1.5 The bonds shall be written with such sureties secured through the Contractor’s usual sources as may be agreeable to the parties. In addition, the sureties shall be authorized to conduct surety business in the state in which the Project is located, and the sureties and any reinsuring companies shall be listed in the current Department of the Treasury circular No. 570 with an underwriting limitation equal to or greater than the penal sum of the bonds to be furnished.

7.1.6 The Contractor 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 attorney-in-fact’s power of attorney.

7.1.7 The Contractor shall submit the bond in triplicate to the Owner not later than the date of execution of the Contract.”

**ARTICLE 8 – FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR: No Changes.**

END OF DOCUMENT 00 22 13
INFORMATION AVAILABLE TO BIDDERS

The following documents contain information about existing conditions which are pertinent to the Work of this Project and are available for the general information of all Bidders. The availability of such information shall not relieve any Bidder from responsibility to visit the Project Site, to become familiar with the local conditions under which the Work is to be performed and to correlate the Bidder's observations with the requirements of the Bidding Documents.

1. SOIL INVESTIGATION REPORT

The Soil Investigation Report No. 16161.20.WIL as prepared by Chosen Valley Testing is for reference purposes only and shall not be considered a part of the Contract Documents. The Architect/Engineer does not certify its completeness or accuracy. The Contractor may do additional testing and evaluation to verify subsurface conditions. A copy of the soil investigation report printed half size on green paper is bound herein following as a part of this Section 00 30 00.

END OF DOCUMENT 00 30 00
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Design Phase Geotechnical Report:

Proposed Remodel and Entry vestibule Addition
Western Technical College –Apprenticeship Center
2806 21st Pl S.
La Crosse, Wisconsin

Prepared for:
Mr. Jay McHenry
Facilities Director
Western Technical College
C/O: Michelle Maland
Architect HSR Associates

January 31, 2020
16161.20.WIL

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly registered engineer under the laws of the State of Wisconsin.

Frederick E. Schuster, PE
Geotechnical Engineer
Registration Number 46610
Date: January 31, 2020
Mr. Jay McHenry  
Facilities Director  
Western Technical College  
C/O: Michelle Maland  
Architect HSR Associates  
100 Milwaukee St.  
La Crosse, WI 54603  
mmaland@hsrassociates.com

Re:  Design Phase Geotechnical Evaluation  
Proposed Remodel and Entry vestibule Addition  
Western Technical College –Apprenticeship Center  
2806 21st Pl S.  
La Crosse, Wisconsin  
CVT Number:  16161.20.WIL

Dear Mr. McHenry,

As authorized, we have completed the geotechnical evaluation for the proposed Western Technical College Apprenticeship Center Remodel at 2806 21st Pl S. in La Crosse, Wisconsin. This letter briefly summarizes the findings in the attached report.

Summary of Boring Results
At the surface, the borings encountered about 2 inches of asphalt over 4½ to 5½ inches of aggregate base.

Beneath pavements, the borings generally were dominated by native clean sands down to termination depths of 10 to 20 feet though the northwest pavement and stormwater borings encountered a layer of silty sand to 2½ to 5 feet below the surface.

Water was not observed during drilling in any of the borings and no overly wet or water bearing samples were recovered. We would expect groundwater levels to fluctuate similarly to nearby creeks and rivers, along with local weather patterns.

Summary of Analysis and Recommendations
We recommend removing all of the existing pavement and any fill materials found, from the building areas, along with any otherwise unsuitable soils and/or existing structures from the building area. These materials should be replaced with engineered granular fill. The clean natural sands dominating at depth appear suitable for foundation and slab support.

Based on the assumed loads and implementation of the earthwork recommendations, we are of the opinion that foundations may be designed to exert pressures of up to 3,000 psf. This allowable bearing pressure includes a safety factor of at least 3 against shear failure.
Based on a bearing pressure of 3,000 psf, total post-construction settlements are expected to be on the order of 1 inch or less. Differential settlement between similarly loaded footings is expected to be on the order of ½ inch or less.

Remarks
CVT appreciates the opportunity to provide geotechnical services on this project. The attached report provides further details of our analysis and recommendations for the building and pavements. If you have any questions about our report, please feel free to contact us at (608) 782-5505.

Sincerely,
Chosen Valley Testing, Inc.

Frederick Schuster, PE
Geotechnical Engineer

Colby T. Verdegan, PE
Sr. Geotechnical/Materials Engineer
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BORING LOCATION SKETCH  
LOG OF BORING # 1-6  
GRADATION CURVES  
SOIL EVALUATION – STORM  
LEGEND TO SOIL DESCRIPTION
A. Introduction

The intent of this report is to present our findings to the client in the same logical sequence that led us to arrive at the opinions and recommendations expressed. Since our services often must be completed before the design is finished, assumptions are often needed to prepare a proper scope and to analyze the data. A complete and thorough review of the entire document, including its assumptions and its appendices, should be undertaken immediately upon receipt.

A.1. Purpose

This geotechnical report was prepared to aid in the design and construction of the Western Technical College Apprenticeship Center Remodel at 2806 21st Pl S. in La Crosse, Wisconsin. Our services were authorized by Mr. Jay McHenry, Facilities Director of Western Technical College.

A.2. Scope

To obtain data for analysis, a total of 6 borings were drilled. One of the soil borings were drilled for the proposed building, three for proposed pavements, and two for the proposed infiltration areas. The building boring was to be drilled to depths of about 20 feet, the pavement borings were drilled to a depth of about 10 feet, and the infiltration borings were drilled to depths of about 15 feet. Our engineering scope consisted of providing our opinions and recommendations for the various geotechnical aspects of the project including allowable soil bearing pressure, settlement, pavement recommendations and preliminary field verification of suitability for water infiltration information in the form of SBD 10793.

A.3. Boring Locations and Elevations

The desired boring locations were indicated on a site plan from the client. The Boring Location Sketch in the Appendix shows the approximate locations as drilled, and was created by superposing the plan and GPS coordinates for the borings onto aerial imagery of the site using Google Earth software. The reader may note that the imagery in the sketch would suggest that Boring B-1 was drilled inside the existing building, when in fact that part of the building was demolished in advance of our drilling operations.

Ground surface elevations at the borings were estimated using a laser level. The finished floor elevation at the center of southeastern garage door of the existing building was used as a benchmark, and was assigned an elevation of 100.0 feet.
A.4. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Geologic maps suggest that the natural soils in the area are primarily alluvial overlying glacial outwash deposits of sands and gravels. Bedrock is commonly found 100 to 150 feet below the surface and consists of the Cambrian System Sandstone.

B. Subsurface Data

Procedures: The borings were performed using penetration test procedures (Method of Test D1586 of the American Society for Testing and Materials). This procedure allows for the extraction of intact soil specimen from deep in the ground. With this method, a hollow-stem auger is drilled to the desired sampling depth. A 2-inch OD sampling tube is then screwed onto the end of a sampling rod, inserted through the hole in the auger's tip, and then driven into the soil with a 140-pound hammer dropped repeatedly from a height of 30 inches above the sampling rod. The sampler is driven 18 inches into the soil, unless the material is too hard. The samples are generally taken at 2½ to 5-foot intervals. The core of soil obtained was classified and logged by the driller on site and a representative portion was then sealed and delivered to the geotechnical engineer for further review.

B.1. Stratification

At the surface, the borings encountered about 2 inches of asphalt over 4½ to 5½ inches of aggregate base.

Beneath pavements, the borings generally were dominated by native clean sands down to termination depths of 10 to 20 feet though the northwest pavement and stormwater borings encountered a layer of silty sand to 2½ to 5 feet below the surface.

For the reader’s convenience, we have summarized the soil boring data on the following cross-section. The reader is referred to the individual Log of Boring sheets in the Appendix for more detailed information.
B.2. Penetration Test and Laboratory Test Results

The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, compaction tests are more meaningful.

The natural clean sands returned penetration resistance values ("N" Value) ranging from 4 to 13 blows per foot (BPF), indicating they were loose to medium dense. The silty sand returned penetration resistance values of 6 blows per foot, indicating they were loose.

A key to descriptors used to qualify the relative density of soil (such as soft, stiff, loose, and dense) can be found on the Legend to Soil Description in the Appendix.

B.3. Groundwater Data

During drilling, the drillers may note the presence of moisture on the sampler, in the cuttings, or in the borehole itself. These findings are reported on the boring logs. Because water levels vary with weather, time of year, and other factors, the presence or lack of water during exploration is subject to interpretation and is not always conclusive.

Water was not observed during drilling in any of the borings and no overly wet or water bearing samples were recovered. We would expect groundwater levels to fluctuate similarly to nearby creeks and rivers, along with local weather patterns.
B.4. Laboratory Testing

Fine sieve analyses were performed on representative samples from the stormwater borings to aid in classification. The following table outlines the results of the analyses and the corresponding USDA soil classification. All tests were performed according to ASTM standards.

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<th>Depth Below Surface (Feet)</th>
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<td>18.0</td>
<td>3.3</td>
<td>2.1</td>
<td>Sand, S</td>
</tr>
</tbody>
</table>

C. Design Data

Because each structure has a different loading configuration and intensity, different grades, and different structural or performance tolerances, the results of a geotechnical exploration will mean different things for different facilities. If the facility changes, Chosen Valley Testing should be contacted to discuss possible implications of the changes. Without a chance to review such changes, the recommendations of the soils engineer may no longer be valid or appropriate.

The project consists of the remodel of an existing building and the construction of an eastern entry vestibule tower, parking lot and stormwater structure in La Crosse, Wisconsin. The entry vestibule tower is understood to be a 25-foot tall, slab-on-grade structure. The vestibule is understood to have a masonry cavity bearing wall perimeter. Foundation loads are assumed to be on the order of a maximum of 10 kips per lineal foot for the footings. It is assumed that the vestibule will have a finished floor elevation near 100 feet to match the existing finished floor, which is slightly above existing grade at the borings.

We have assumed that the parking areas will experience primarily light to moderate traffic loads.

D. Analysis

We recommend removing all of the existing pavement and any fill materials found, from the building areas, along with any otherwise unsuitable soils and/or existing structures from the building area. These materials should be replaced with engineered granular fill. The clean natural sands dominating at depth appear suitable for foundation and slab support.

Based on the assumed loads and implementation of the earthwork recommendations, we are of the opinion that foundations may be designed to exert pressures of up to 3,000 psf. This allowable bearing pressure includes a safety factor of at least 3 against shear failure.

Based on a bearing pressure of 3,000 psf, total post-construction settlements are expected to be on the order of 1 inch or less. Differential settlement between similarly loaded footings is expected to be on the order
The remainder of the report provides more details of our recommendations

E. Recommendations-Excavation/Backfill

E.1. Grading Recommendations

E.1.a. Stripping and Excavation: We recommend removing the existing pavements from below the entire building area. We recommend removing any existing structures, fill, and any other unsuitable soils encountered from below the entire building area. The existing pavements were about ½ to ¾ feet deep at the boring locations though deeper amounts of existing fill should be expected near existing building footings.

E.1.b. Subgrade Evaluation and Surface Compaction: The bearing soils in the footing trenches should be evaluated by CVT personnel before placing fill or foundations. Any unsuitable material observed should be removed and replaced with engineered fill.

E.1.c. Oversizing: Any stripping or corrective excavations should be oversized at least 1 foot beyond the foundations for each foot of fill needed below footing grade. This oversizing can be reduced by up to 50% if rather precise staking is present during grading.

E.1.d. Filling and Compaction: We recommend using clean sands or gravels having less than 12% particles passing a #200 sieve, where fill is needed below the foundations and slabs. The majority of on-site soils, particularly at depth, appear to meet this gradation.

We recommend placing a layer of clean sand, having less than 5% particles passing the number 200 sieve, as fill in the upper 4 to 6 inches of the subgrade (just below slabs).

All materials below the building, in the oversized areas, or used as backfill for walls should be compacted to a minimum of 95% of its maximum standard Proctor density (ASTM D 698).

E.2. Building Design

E.2.a. Foundation Depth: We recommend placing exterior foundations at least 48 inches below the exposed ground surface for frost protection. Interior foundations in heated areas may be placed directly below slabs. Footings for unheated structures should be placed at least 60 inches below the exposed ground surface.

Footings adjoining existing structures or within the influence zone affecting footings for existing structures are recommended to match the adjoining structure’s footing depth, unless an analysis has been completed to verify that the existing structure can withstand the additional loading.

E.2.b. Bearing Capacity: Based on the assumed loads and implementation of the earthwork
recommendations, we are of the opinion that foundations may be designed to exert pressures of up to 3,000 psf. This allowable bearing pressure includes a safety factor of at least 3 against shear failure.

E.2.c.  Settlement: Based on a bearing pressure of 3,000 psf, total post-construction settlements are expected to be less than 1 inch. Differential settlement between similarly loaded footings is expected to be less than ½ inch.

E.2.d.  Vapor Barrier: If the slab will receive coverings that are less permeable than concrete, a vapor barrier should be placed below the slab. Some contractors prefer to place this barrier below the sand, to limit the potential for curling.

E.2.e.  Slab Design: The completed slab subgrade is expected to consist of primarily engineered granular fill overlying natural clean sands. We recommend using a modulus of subgrade reaction of no more than 200 pounds per cubic inch (pci) for these conditions.

We typically recommend placing a layer of clean sand, having less than 5% particles passing the number 200 sieve, as fill in the upper 4 to 6 inches of the subgrade (just below slabs) to prevent curling. Because the upper sands on site are dominantly clean this should not be necessary.

E.2.f.  Lateral Earth Pressures: We recommend using clean, free-draining sands or gravels having equal to or less than 12% fines as fill against the below-grade walls. This fill should be compacted to at least 95% of its maximum standard Proctor density (ASTM D 698). The top of the sand should be capped with clayey topsoil or pavement. A drain tile is normally included at the base of the wall backfill to prevent moisture from collecting behind the wall. Because sands dominate at depth and groundwater was not observed, such a drain tile would not likely receive water on this site.

The following table provides recommended support values for the recommended clean sand backfill. These values do not include a safety factor.

<table>
<thead>
<tr>
<th>Poorly Graded Sands (SP) 95% standard Proctor density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Friction Angle (degrees)</td>
</tr>
<tr>
<td>Cohesion (psf)</td>
</tr>
<tr>
<td>Coefficient of Friction between Concrete and Soil</td>
</tr>
<tr>
<td>Moist Unit Weight (pcf)</td>
</tr>
<tr>
<td>At-Rest Coefficient (Ko)</td>
</tr>
<tr>
<td>Active Coefficient (Ka)</td>
</tr>
<tr>
<td>Passive Coefficient (Kp)</td>
</tr>
</tbody>
</table>

The actual loads exerted on the structure will depend on the movement or flexure of the structure. For sand fill, horizontal movement or flexure of about 0.2% of the height of soil retained may be sufficient to mobilize frictional forces from the at-rest state to the active state.
F. Paved Areas

F.1. Stripping and Grading

We recommend stripping and removing the existing pavements from the areas that will have pavements placed, along with any topsoil materials that may be present within 2 feet of pavement section. Subgrades should be scarified to encourage uniformity and compacted as needed to pass a test roll. New fill needed in paved areas should consist of a uniform soil type. We recommend using imported or onsite, sands or gravels having less than 20% particles passing a number 200 sieve below all paved areas.

All fill in paved areas should be compacted to at least 95% of its maximum standard Proctor density. Compaction to 90% is usually sufficient in green areas.

The completed pavement subgrade should be able to pass a test roll. Areas not passing the test roll should be reworked and stabilized as needed to pass the test roll.

F.2. Pavement Design

As mentioned, silty sands and clean sands are expected to be the dominant materials present at subgrade elevation. We recommend designing pavements using support values with the following estimated characteristics:

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>AASHTO Classification</th>
<th>Frost Index</th>
<th>Design Group Index</th>
<th>K-Value</th>
<th>Soil Support Factor</th>
<th>Est. California Bearing Ratio</th>
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</thead>
<tbody>
<tr>
<td>Sand</td>
<td>A-3</td>
<td>F-2</td>
<td>6</td>
<td>250</td>
<td>5.0</td>
<td>10 – 20</td>
</tr>
<tr>
<td>Silty Sand</td>
<td>A-2-4/A-4</td>
<td>F-3</td>
<td>10</td>
<td>200</td>
<td>4.5</td>
<td>5 – 15</td>
</tr>
</tbody>
</table>

Again, the proposed parking areas are assumed to experience primarily auto traffic and occasional commercial truck traffic. We recommend a minimum pavement section consisting of at least 3 inches of bituminous and 6 inches of aggregate base in auto traffic areas. In more frequent heavy commercial truck traffic areas, we recommend increasing the sections to 4 inches of bituminous and 8 inches of aggregate base. These sections should be considered preliminary, subject to review by the project civil engineering consultant, and subject to their experience with pavement design and performance in the area of the project.

The above pavement section assumes that the subgrade has been sufficiently scarified and compacted to pass a test roll. Observation of the test roll should be documented by qualified geotechnical personnel. The necessity of scarifying and recompacting the subgrade would be determined by the test roll.

These sections should be considered preliminary, subject to review by the project civil engineering consultant, and subject to their experience with pavement design and performance in the area of the project.
G. Stormwater Recommendations

As requested, infiltration rates were estimated for the various materials encountered in the site (Borings B-5 and B-6). These borings encountered pavement materials overlying materials ranging from sands to loamy sands. Infiltration rates for these materials were estimated to range from 3.60 to 1.63 inches per hour, based on USDA soil classification. The infiltration/permeability values are the recommended design values from the Wisconsin DNR. Please see the Soil Evaluation – Storm sheets in the Appendix for more details.

Double-ring infiltrometer testing could be performed to provide site specific infiltration values, but was not part of our initial work scope.

H. General Grading Recommendations

H.1. Excavation

Stripping can likely be performed with a variety of equipment, provided the soils are not too dry. The deep excavations will require the use of a backhoe. A backhoe with a smooth lipped bucket is recommended to limit disturbance of the natural bearing soils.

H.2. Sideslopes

The contractor will be required to slope or shore the excavations as needed to meet OSHA requirements for safety and to limit disturbance to surrounding structures. The imported sand fill and natural clean sands on site are expected to be primarily Type C soils as defined by OSHA.

H.3. Cold Weather

If the excavation occurs during freezing temperatures, good winter construction practices should be used. Frozen fill should be thawed before placing and filling should not be placed on frozen ground. Slab areas should be completely thawed prior to placing concrete.

H.4. Construction Testing and Documentation

The bottom of the excavations should be evaluated and documented by qualified geotechnical personnel to assess the soils at bearing depth. Any fill placed below building areas should be evaluated for conformance to the project gradation recommendations and should be tested for compaction. If filling proceeds during periods of freezing weather, full-time testing should be considered to help confirm that imported fill is thawed prior to and during compaction, and that all snow has been removed before placement of the fill.

Although our firm offers testing services relating to civil and structural components of the structure (such
as concrete testing, reinforcement observations, etc.), specification of such services are beyond our work scope and the designer should be consulted as to such requirements.

I. Level of Care

The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.
Appendix

Boring Location Sketch
Log of Boring # 1-6
Gradation Curves
Soil Evaluation - Storm
Legend to Soil Description
Boring Location Sketch
Proposed Remodel and Entry vestibule Addition
Western Technical College – Apprenticeship Center
2806 21st Pl S.
La Crosse, Wisconsin
16161.20.WIL
Benchmark: Finished floor of the existing building at the garage door west of the site, assigned elevation 100 feet.

**Description of Materials**

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
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</thead>
<tbody>
<tr>
<td>99.4</td>
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<td>SP</td>
<td>2.5'' ASPHALT</td>
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<td>Benchmark: Finished floor of the existing building at the garage door west of the site, assigned elevation 100 feet.</td>
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<tr>
<td>92.1</td>
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<tr>
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<td></td>
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**LOCATION:** See attached sketch

**DATE:** 1/23/2020

**SCALE:** 1" = 3'

**PROJECT:** Design Phase Geotechnical Evaluation
Proposed Remodel and Entry Vestibule Addition
2806 21st Place S
La Crosse, Wisconsin
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LOCATION: See attached sketch

DATE: 1/23/2020
SCALE: 1" = 3'
### LOG OF BORING

**PROJECT:** 16161.20.WIL  
Design Phase Geotechnical Evaluation  
Proposed Remodel and Entry Vestibule Addition  
2806 21st Place S  
La Crosse, Wisconsin

**BORING:** B-5

**LOCATION:** See attached sketch

**DATE:** 1/23/2020  
**SCALE:** 1" = 3'

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Boring sealed upon completion. |     |    |                 |
## Description of Materials

### POSSIBLE MATERIALS

#### LOCATION:

**SILTY SAND**
- fine grained, brown, moist, loose.
- (Alluvium)

#### LOCATION:

**POORLY GRADED SAND**
- fine to medium grained, grayish brown, moist, loose.
- (Alluvium)

### Tests and Notes

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**SCALE:** 1" = 3'
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<td>4.75</td>
<td>0.35</td>
<td>0.263</td>
<td>0.1258</td>
<td>0.0</td>
<td>94.4</td>
<td>5.1</td>
<td></td>
</tr>
</tbody>
</table>

### Project Information

**Project:** Proposed Remodel and Entry Vestibule Addition - 2806 21st Place S  
**Job No.:** 16161.20.WIL  
**Date:** 1/30/20

**Gradation Curves**  
Chosen Valley Testing
<table>
<thead>
<tr>
<th>Specimen Identification</th>
<th>Classification</th>
<th>COBBLES</th>
<th>GRAVEL</th>
<th>SAND</th>
<th>SILT OR CLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>coarse</td>
<td>fine</td>
<td>coarse</td>
<td>medium</td>
</tr>
<tr>
<td>● B-6</td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POORLY GRADED SAND SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specimen Identification</th>
<th>D100</th>
<th>D60</th>
<th>D30</th>
<th>D10</th>
<th>%Gravel</th>
<th>%Sand</th>
<th>%Silt</th>
<th>%Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>● B-6</td>
<td>5.0</td>
<td>4.75</td>
<td>0.37</td>
<td>0.279</td>
<td>0.1569</td>
<td>0.0</td>
<td>97.3</td>
<td>2.7</td>
</tr>
</tbody>
</table>

PROJECT: Proposed Remodel and Entry Vestibule Addition - 2806 21st Place S
JOB NO.: 16161.20.WIL
DATE: 1/30/20

GRADATION CURVES
Chosen Valley Testing
SOIL AND SITE EVALUATION – STORM

Attach a complete site plan on paper not less than 8 ½ x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent of slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information

Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m)].

County
La Crosse

Parcel I.D.

Reviewed by:

Date:

Property Owner

Property Location

Western Technical College

Govt. Lot
NW ¼

Lot #: 16

T

15

N

7

X (or W)

Subd. Name or CSM #

City
La Crosse

State
WI

Zip Code
54601

Phone Number

Drainage area _______________

Hydraulic Application Test Method

Morphological Evaluation

Double Ring Infiltrometer

Other: (specify)

Soil Moisture Date of soil borings: 1/23/2019

USDA-NRCS WETS Value:

Dry = 1;

Normal = 2;

Wet = 3.

Horizon

Depth in.

Dominant Color

Munsell

Redox Description

Qu. Sz. Cont. Color

Texture

Structure

Gr. Sz. Sh.

Consistence

Boundary

% Rock Frags.

% Fines

Hydraulic App Rate Inches/Hr

B-5

# OBS.  Pit  Boring

Ground surface elevation.  96.6  ft.

Elevation of limiting factor  <80.6  ft.

2" ASPHALT

5" AGGREGATE BASE

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth in.</th>
<th>Dominant Color</th>
<th>Redox Description</th>
<th>Texture</th>
<th>Structure</th>
<th>Gr. Sz. Sh.</th>
<th>Consistence</th>
<th>Boundary</th>
<th>% Rock Frags.</th>
<th>% Fines</th>
<th>Hydraulic App Rate Inches/Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7-180</td>
<td>10YR 5/3</td>
<td>S</td>
<td>0sg</td>
<td>ml</td>
<td></td>
<td></td>
<td></td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>3.60</td>
</tr>
</tbody>
</table>

Comments:

Finished floor of the existing building at the garage door west of the site, assigned elevation 100 feet.

B-6

# OBS.  Pit  Boring

Ground surface elevation.  96.6  ft.

Elevation of limiting factor  <81.6  ft.

2" ASPHALT

5.5" AGGREGATE BASE

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth in.</th>
<th>Dominant Color</th>
<th>Redox Description</th>
<th>Texture</th>
<th>Structure</th>
<th>Gr. Sz. Sh.</th>
<th>Consistence</th>
<th>Boundary</th>
<th>% Rock Frags.</th>
<th>% Fines</th>
<th>Hydraulic App Rate Inches/Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.5-30</td>
<td>10YR 4/4</td>
<td>LS</td>
<td>0sg</td>
<td>ml</td>
<td>gw</td>
<td></td>
<td></td>
<td>&lt;10</td>
<td>15-25</td>
<td>1.63</td>
</tr>
<tr>
<td>2</td>
<td>30-180</td>
<td>10YR 5/3</td>
<td>S</td>
<td>0sg</td>
<td>ml</td>
<td></td>
<td></td>
<td></td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>3.60</td>
</tr>
</tbody>
</table>

Comments:

Finished floor of the existing building at the garage door west of the site, assigned elevation 100 feet.

F. Schuster, PE

CST 1356630 / PE 46610

Address
1019 2nd Ave. S.W., Onalaska, WI 54650

Date Evaluation Conducted
1/30/2019

Telephone Number
608-762-5505
### Unified Soil Classification (ASTM D-2487/2488)

<table>
<thead>
<tr>
<th>Material Types</th>
<th>Criteria for Assigning Soil Group Names</th>
<th>Group Symbol</th>
<th>Soil Group Names &amp; Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels &gt;50% of Coarse Fraction Retained on No. 4. Sieve</td>
<td>Clean Gravels &lt;5% Finest</td>
<td>Cu&lt;4 AND 1&lt;Cc&lt;3</td>
<td>GW WELL-GRADED GRAVEL</td>
</tr>
<tr>
<td></td>
<td>Gravels With Finest &gt;12% Finest</td>
<td>Cu&gt;4 AND 1&gt;Cc&lt;3</td>
<td>GP POORLY-GRADED GRAVEL</td>
</tr>
<tr>
<td>Sands &gt;50% of Coarse Fraction Passes on No. 4. Sieve</td>
<td>Clean Sands &lt;5% Finest</td>
<td>Cu&gt;6 AND 1&gt;Cc&lt;3</td>
<td>SW WELL-GRADED SAND</td>
</tr>
<tr>
<td></td>
<td>Sands and Finest &gt;12% Finest</td>
<td>Cu&gt;6 AND 1&gt;Cc&lt;3</td>
<td>SP POORLY-GRADED SAND</td>
</tr>
<tr>
<td>Silts and Clays Liquid Limit&lt;50</td>
<td>Inorganic</td>
<td>Pr&gt;7 AND PLots &gt;“A” Line</td>
<td>CL LEAN CLAY</td>
</tr>
<tr>
<td></td>
<td>Organic</td>
<td>Pr&lt;4 AND PLots &gt;“A” Line</td>
<td>ML SILT</td>
</tr>
<tr>
<td>Silts and Clays Liquid Limit&gt;50</td>
<td>Inorganic</td>
<td>PLots &gt;“A” Line</td>
<td>CH FAT CLAY</td>
</tr>
<tr>
<td></td>
<td>Organic</td>
<td>PLots &lt;“A” Line</td>
<td>MH ELASTIC SILT</td>
</tr>
<tr>
<td>Highly Organic Soils</td>
<td>Primarily Organic Matter, Dark in Color, and Organic Odor</td>
<td>PT PEAT</td>
<td></td>
</tr>
</tbody>
</table>

### SAMPLE TYPES

- Hollow Stem
- Standard Penetration Test

### TEST SYMBOLS

- MC - Moisture Content
- OC - Organic Content
- CN - Consolidation
- DD - Dry Density
- PP - Pocket Penetrometer
- RV - R-Value
- SA - Sieve Analysis
- P200 - % Passing #200 Sieve

### Penetration Resistance (Recorded as Bows / 0.5 Ft)

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Relative Density</th>
<th>Consistency</th>
<th>Blows/Foot</th>
<th>Compressive Strength (TSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand &amp; Gravel</td>
<td>Very Loose 0 - 4</td>
<td>0 - 1</td>
<td>0 - 0.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loose 4 - 10</td>
<td>2 - 3</td>
<td>0.25 - 0.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium Dense 10 - 30</td>
<td>4 - 5</td>
<td>0.50 - 1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dense 30 - 50</td>
<td>9 - 12</td>
<td>1.0 - 2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very Dense OVER 50</td>
<td>15 - 30</td>
<td>2.0 - 4.0</td>
<td></td>
</tr>
</tbody>
</table>

### PENETRATION RESISTANCE (RECORDED AS BOWS / 0.5 FT)

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Relative Density</th>
<th>Consistency</th>
<th>Blows/Foot</th>
<th>Compressive Strength (TSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silts &amp; Clays</td>
<td>Very Soft 0 - 4</td>
<td>0 - 1</td>
<td>0 - 0.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soft 2 - 3</td>
<td>2 - 3</td>
<td>0.25 - 0.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium 4 - 5</td>
<td>4 - 5</td>
<td>0.50 - 1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rather Soft 6 - 8</td>
<td>6 - 8</td>
<td>1.0 - 2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rather STiff 9 - 12</td>
<td>9 - 12</td>
<td>1.0 - 2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STiff 13 - 16</td>
<td>13 - 16</td>
<td>2.0 - 4.0</td>
<td></td>
</tr>
</tbody>
</table>

### Water Level (With Time of Measurement)

- LL - Liquid Limit
- PI - Plasticity Index
- SW - Swell Test
- UU - Unconsolidated Undrained Triaxial

### Grain Size Terminology

- Boulder > 12 in.
- Cobble 3 in. - 12 in.
- Gravel #4 sieve to 3 in.
- Sand #200 sieve to #4 sieve
- Silt or Clay Passing #200 sieve

### Plasticity Chart

- Very Loose
- Loose
- Medium Dense
- Dense
- Very Dense
- Hard

### Chosen Valley Testing

- Job No. CVT
- LEGEND TO SOIL DESCRIPTIONS

---

---
BIDDER:________________________________________________________________________

BID FOR SINGLE PRIME CONTRACT

PROJECT:  WESTERN TECHNICAL COLLEGE
          APPRENTICESHIP CENTER REMODEL
          2860 21ST PLACE SOUTH
          LA CROSSE, WISCONSIN 54601
          HSR PROJECT NO. 19021

TO:      WESTERN TECHNICAL COLLEGE
          505 9TH STREET NORTH
          LA CROSSE, WISCONSIN 54601
          ATT: JAY McHENRY – DIRECTOR OF FACILITIES

BASE BID

The undersigned, having examined the site where the Work is to be executed and become familiar with
local conditions affecting the cost of the Work and carefully examined the Project Manual, the Project
Drawings, all other Bidding Documents and Addenda thereto prepared by the AE, HSR Associates, Inc.,
hereby agrees to provide all labor, materials, equipment and services necessary for the complete and
satisfactory execution of the ENTIRE WORK, in the time frame stipulated in these contract documents,
for the Base Bid stipulated sum of:

$ ___________ ____________ 00

ALTERNATE BIDS

The undersigned further agrees to perform the alternative portions of the Work as described in the
Project Manual, Section 01 23 00 Alternates, for the following additions to the Base Bid sum stipulated
above:

Alternate No. 1  Parking Lot & Site work
Add $ ___________ ____________ 00

Alternate No. 2 HVAC
Add $ ___________ ____________ 00
Alternate No. 3 Exterior Renovation & Addition

Add ________________________________ Dollars ($________________.00)

Alternate No. 4 Wall Removal

Add/Deduct ________________________________ Dollars ($________________.00)

Alternate No. 5 Electrical Panel Replacement

Add ________________________________ Dollars ($________________.00)

BIDDER’S CHOICE SUBSTITUTIONS

The following Bidder’s Choice Substitution is proposed for your consideration subject to the requirements set forth in Document 00 22 13 Supplementary Instructions to Bidders, Subparagraph 3.3.4:

Substitution No. S1:

For substituting______________________________________________________________
____________________________________________________________________________
Type, Brand, Catalog No._____________________________________________________
Manufacturer________________________________________________________________

Deduct from BASE BID ________________________________ Dollars ($________________.00)

In submitting this Bid, the undersigned agrees to:

1. Hold this Bid open for 30 days.
2. Accept the provisions of Instructions to Bidders regarding disposition of Bid Security.
3. Enter into and execute an Agreement, if awarded on the basis of this Bid, and to furnish Performance and Labor and Material Payment Bonds according to the Supplementary Conditions.
4. Accomplish work according to the Contract Documents.
5. Complete the work by the time stated in Section 01 10 00 Summary of the Work.

Receipt of the following Addenda and inclusion of their provisions in this Bid is hereby acknowledged:

Addendum No._______ Dated____________
Addendum No._______ Dated____________
Addendum No._______ Dated____________
Addendum No._______ Dated____________
Addendum No._______ Dated____________

19021 Western Apprenticeship
Center Remodel 00 41 00-2
Attached hereto are the required:

a. ( ) Bid Security
b. ( ) Section 00 45 13 Certificate of Organization and Authority
c. ( ) Section 00 45 17 Non-Collusive Affidavit: An affidavit in proof that the undersigned has not entered into any collusion with any person in respect to this Bid or any other bid or the submitting of bids for the contract for which this bid is submitted.
d. ( ) Section 00 45 19 Certification of Non-segregated Facilities

FIRM NAME: ________________________________________________

(Affix seal if Corporation) By: ________________________________________________

Title: __________________________________________________________

By: ____________________________________________________________

Title: __________________________________________________________

Date: __________________________________________________________

Official Address: ______________________________________________

_________________________________________________________________

Telephone: ______________________________________________________

END OF DOCUMENT 00 41 00
Page Intentionally Left Blank
CERTIFICATE OF ORGANIZATION AND AUTHORITY

(State of ______________________)

(County of _____________________)

I hereby certify that the Bidder on the attached Bid Form is organized as indicated below and that all statements herein are made on behalf of such Bidder. (Fill out applicable paragraph)

CORPORATION: The Bidder is a corporation organized and existing under the laws of the State of ____________________________________

President: ______________________________________

Secretary: ______________________________________

PARTNERSHIP: The Bidder is a partnership consisting of the following partners:

______________________________________________

______________________________________________

and ___________________________________________

SOLE TRADER: The Bidder is an individual operating under the following trade name:

______________________________________________

ADDRESS: The Bidder's business address is: _______________________________________

______________________________________________

STATUTORY CERTIFICATE

I hereby further certify that I have examined and carefully prepared this Bid from the Project Drawings, Project Manual and other Bidding Documents, have checked the same in detail before submitting this Bid, and have full authority to make these statements, to submit this Bid on behalf of the above mentioned Bidder, and that the above statements are true and correct.

BIDDER: ______________________________________

BY: ___________________________________________

Subscribed and sworn to before me this ____________ day of _____, 20___,

_____________________________________________ Notary Public.

My commission expires __________________________, 20____.

END OF DOCUMENT 00 45 13
NON-COLLUSIVE AFFIDAVIT

(State of_______________________)
(County of_______________________)

__________________________________________ being duly sworn, deposes and says that:

1. S/He is (owner, partner, officer, representative, or agent) of the Bidder that has submitted the attached Bid;
2. S/He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham Bid;
4. Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against WESTERN TECHNICAL COLLEGE or any person interested in the proposed Contract; and
5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

_______________________________________________
Signed

_______________________________________________
Title

Subscribed and sworn to before me this

___________________________ day of _____________ 20___.

___________________________________ Notary Public

________________________________________ County

My commission expires: __________________________

END OF DOCUMENT 00 45 17
CERTIFICATION OF NONSEGREGATED FACILITIES

The Bidder certifies that he/she does not maintain or provide for his/her employees any segregated facilities at any of his/her establishments and that he/she does not permit his/her employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The Bidder certifies further that he/she will not maintain or provide for his/her employees any segregated facilities at any of his/her establishments and that he/she will not permit his/her employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The Bidder agrees that a breach of this certification will be a violation of the Equal Opportunity Clause in any Contract resulting from acceptance of this Bid. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or natural origin, because of habit, local custom or otherwise. The Bidder agrees that (except where he/she has obtained identical certification from proposed subcontractors for specific time periods) he/she will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that he/she will retain such certifications in his/her files.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. Section 1001.

Date: ___________________, 20______.

_______________________________________________
(Name of Bidder)

By: ___________________________________________

Title: ___________________________________________

Official Address (Including Zip Code):

_______________________________________________
_______________________________________________
_______________________________________________
_______________________________________________

END OF DOCUMENT 00 45 19
AGREEMENT FORMS

The following agreement form will be provided by the Owner and shall be reviewed and completed by the successful Contractor and submitted to the Owner at the Owner's direction following notification.


END OF DOCUMENT 00 52 13
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)

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

☐ Not later than ( ) calendar days from the date of commencement of the Work.
§ 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:

<table>
<thead>
<tr>
<th>Portion of Work</th>
<th>Substantial Completion Date</th>
</tr>
</thead>
</table>

§ 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:

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
</table>

§ 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.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
<th>Conditions for Acceptance</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
</table>

§ 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.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Units and Limitations</th>
<th>Price per Unit ($0.00)</th>
</tr>
</thead>
</table>

§ 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 The following items are not subject to retainage:
(Insert any items not subject to 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:

☐ 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

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.6 Specifications

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.7 Addenda, if any:

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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:
(Identify the exhibit 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.)

Sample
The Sustainability Plan:

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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)

(Printed name and title)

CONTRACTOR (Signature)

(Printed name and title)
1. SURETY BONDS

a. Refer to AIA A201 Article 11 and Section 00 74 00 Owners Instructions for Bonds and Insurance.

b. Form of bond shall be “Public Improvement Performance/Labor and Material Payment Bond,” pursuant to Section 779.14 Wisconsin Statutes, WIS. AIA Document WIS A312, published by the Wisconsin Society of Architects/AIA.

c. All bonds shall be signed by an agent or official of the surety company and shall include the certified power of attorney provided by the surety company showing that the person who signs the bonds has the power of attorney to so sign for the surety company. Such certification shall be signed by the Secretary or Assistant Secretary of the company and not by an attorney-in-fact. This certification shall bear the same or earlier date as the bonds.

d. Surety company shall have a B, or better, rating by the “Best Guide,” licensed to do business in the State of Wisconsin.

e. Provide four copies each of the bonds and the power of attorney to attachment to each copy of the Agreement.

f. Contractor shall pay the premiums for the surety bonds.

g. Date of Agreement and surety bonds shall be the same.

h. Contractor shall sign the bonds, consistent with the following, as applicable:
   1). Under a partnership or a joint venture, the Agreement may be signed by one partner of the partnership, or one partner of each firm comprising the joint venture, but the surety bonds shall be signed by all partners.
   2). Under a corporation, the bonds shall be signed by the official signing the Agreement and the corporate seal affixed to the Agreement and the surety bonds. If the corporation has no seal, include a statement to the effect that the corporation has no seal.

2. AVAILABILITY OF FORMS

Sample document forms as specified above are attached hereto, and may be purchased directly from:

WISCONSIN SOCIETY OF ARCHITECTS/AIA
321 South Hamilton Street
Madison, Wisconsin  53703
Telephone:  (608) 257-8477 or  (800) 272-4483

END OF DOCUMENT 00 61 13
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CONSENT OF SURETY TO FINAL PAYMENT

PROJECT: WESTERN TECHNICAL COLLEGE
APPRENTICESHIP CENTER REMODEL
2860 21ST PLACE SOUTH
LA CROSSE, WISCONSIN 54601
HSR PROJECT NO. 19021

OWNER: WESTERN TECHNICAL COLLEGE
PHYSICAL PLANT OFFICE
505 9th STREET NORTH
LA CROSSE, WISCONSIN 54601
ATT: JAY McHENRY – DIRECTOR OF FACILITIES

CONTRACTOR: ______________________________

CONTRACT FOR: ENTIRE WORK for sgl prime.

CONTRACT DATE: ____________________________

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, _______________________________ SURETY COMPANY, on bond of ________________________________, Contractor, hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety Company of any of its obligations to the Owner, named above, as set forth in said Surety Company's bond.

It is further agreed that, in giving this consent, the Surety has made its own investigation to determine that said payment should be made to the Contractor and has not relied on any representation by the Architect/Engineer which has induced it to consent to such payment. Surety hereby expressly waives all claims against the Architect/Engineer and the Owner for wrongful release of funds to the Contractor.

IN WITNESS WHEREOF,

The Surety Company has hereunto set its hand this day of ____________, 20____.

Surety Company ________________________________

Attest: Signature of Authorized Representative ________________________________

(Seal)

Title ________________________________

END OF DOCUMENT 00 62 20
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GENERAL CONDITIONS

The "General Conditions of the Contract for Construction" AIA Document A201, 2017 Edition, Articles 1-15, are hereby made a part of this Project Manual except as amended by Document 00 73 00 - Supplementary Conditions.

END OF DOCUMENT 00 72 00
Page Intentionally Left Blank
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 13.2. 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 parts

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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 4.2.2, 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 to 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 provide the job site supervision thereof and shall be solely responsible for the job site 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 characteristics 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
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 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 Contractor: 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
§ 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, consultants 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 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 to 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.
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, 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 Contractor 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 term. 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 Architect 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
§ 9.8.1 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 the work, the Owner and Contractor have accepted the work, 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.

§ 9.8.2 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.

§ 9.8.3 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 the 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 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 had it 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 the 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.
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 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 Contractor 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 Except 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, 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 the Claim and within ten days of the receipt of the 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 other experts 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 the 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.
The following amendments modify, delete and add to the AIA Document A201-2017 General Conditions. Where any article, paragraph or subparagraph in the General Conditions is supplemented by one of the following paragraphs, the provisions of such article, paragraph or subparagraph shall remain in effect and the supplemental provisions shall be considered as added thereto. Where any article, paragraph or subparagraph of the General Conditions is not supplemented, amended, voided or superseded by any of the following paragraphs, the provisions of such Article, paragraph or subparagraph not so amended, voided or superseded shall remain in effect. Amendments are as follows:

1. ARTICLE 1 – GENERAL PROVISIONS

   1.1 BASIC DEFINITIONS

   1.1.3 THE WORK

   At the end of subparagraph 1.1.3, add the following new clause:

   “Use of the word ‘provided’ shall also include ‘furnish and install’.”

   1.1.4 THE PROJECT

   Add the following sentence:

   “A detailed description of the Project is in Document 00 11 13.”

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

   After 1.2.3, add the following:

   “1.2.4 Where a number is listed in the Project Manual (as for gauges, weights, temperatures, amount of time, etc.) the number shall be interpreted as that or better.

   1.2.5 Whenever the words ‘approved’, ‘satisfactory’, ‘directed’, ‘submitted’, ‘inspected’, or similar words or phrases are used in the product specification sections, it shall be assumed that the words ‘Architect/Engineer or his representative’ follows the verb as the object of the clause, such as ‘approved by the Architect/Engineer or his representative’.”

2. ARTICLE 2 – OWNER

2.1 GENERAL

   After 2.1.2, add the following:

   “2.1.3 Refer to Document 00 22 13 for a detailed description of the Owner.”
3. **ARTICLE 3 – CONTRACTOR**

3.3 **SUPERVISION AND CONSTRUCTION PROCEDURES**

After 3.3.3, add the following:

“3.3.4 Refer to Section 01 40 00 for detailed quality control requirements.”

3.5 **WARRANTY**

After 3.5.1, add the following:

“3.5.1.1 Where the Contract Documents require Work better than that required by statute, the Contract Documents shall govern.”

“3.5.1.2 Contractor shall correct defective Work within two year period after Date of Substantial Completion. This time frame does not change or supercede specific manufacturer’s equipment or product warranty time frames.”

3.6 **TAXES**

After 3.6.1, add the following:

“3.6.2 As of July 1, 2018, and in accordance with Section 77.54(9m), Wis. Stats. (2015-2016) Wisconsin contractors are exempt from sales tax on real property materials purchased for this Project. A Wisconsin Sales and Use Tax Exemption Certificate will be included with the contract.

The exemption only applies to a contractor’s purchase of materials and other components that become part of a real property improvement that is a "facility." The sale of a real property improvement is not subject to tax, regardless of who is the purchaser.

"Facility" means any building, shelter, parking lot, parking garage, athletic field, athletic park, storm sewer, water supply system, or sewerage and waste water treatment facility, but does not include a highway, street, or road.

The exemption does not apply to lab equipment or other property that remains tangible personal property after sale or installation. However, all of a Wisconsin Technical College's purchases of tangible personal property are already exempt from tax. The contractor may purchase property without tax, for resale, that remains tangible personal property after sale or installation. The contractor must be sure to make all invoices and other billing documents out in the name of the Wisconsin Technical College District to substantiate that its sale was to an exempt entity.”

3.7 **PERMITS, FEES AND NOTICES**

After subparagraph 3.7.1, add the following:

3.7.1.1 Contractor shall provide permits for driveway/curb-cuts, and cost for relocation of light poles and trees.”

3.7.4 Change “14 days after first observance” to “10 days after first observance”.
3.12 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

After 3.12.6, add the following:

“3.12.6.1 Contractor shall use a verification stamp with signature and date to signify his approval of Shop Drawings.”

“3.12.6.2 Refer to Sections 01 30 00, 01 40 00 and 01 60 00 for detailed submittal information.”

3.14 CUTTING AND PATCHING

After 3.14.2, add the following:

“3.14.3 Refer to Section 01 70 00 for detailed cutting and patching requirements.”

4. ARTICLE 4 – ARCHITECT

4.1 ARCHITECT

Clarification: Wherever the term “Architect” appears, it shall be changed to “Architect/Engineer (AE)”.

After 4.1.1, add the following:

“4.1.1.1 Refer to Document 00 21 13 for a detailed description of the AE and any applicable consultants.”

5. ARTICLE 5 – SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

At 5.2.1, Delete the first sentence, replace with the following:

“The successful bidder, within 10 calendar days from notification of selection for award of contract, shall furnish in writing to the Owner through the Architect a listing of major subcontractors and suppliers, their address, phone number, and the portions of the work which they will perform.”

6. ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS: No Changes.

7. ARTICLE 7 – CHANGES IN THE WORK

7.2 CHANGE ORDERS

After 7.2.1 add the following:

“7.2.2 Refer to Section 01 20 00 and 7.3.4 below for detailed change order procedures.”
7.3 CONSTRUCTION CHANGE DIRECTIVES

“7.3.4 At the end of the first sentence, delete the words, “a reasonable amount”, and substitute, “an allowance for overhead and profit in accordance with percentage fee stated in Subparagraph 7.3.11 below.”

After 7.3.10, add the following subparagraph:

“7.3.11 In Subparagraphs 7.3.3 and 7.3.4 the percentage fee allowance for the combined overhead and profit included in the total cost to the Owner shall be based on the following schedule:

.1 for the Contractor, for Work performed by the Contractor's own forces, 15 percent of the cost.
.2 for the Contractor, for Work performed by the Contractor's Subcontractor, 10 percent of the amount due the Subcontractor.
.3 for each Subcontractor or Sub-subcontractor involved, for Work performed by that Subcontractor's or Sub-subcontractor's own forces, 15 percent of the cost.
.4 for each Subcontractor, for Work performed by the Subcontractor's Sub-subcontractor, 10 percent of the amount due the Sub-subcontractor.
.5 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in manner prescribed above. Where major cost items are subcontracts, they shall be itemized also. In no case will a change involving over $500.00 be approved without such itemization.”

7.4 MINOR CHANGES IN THE WORK.

After 7.4, add the following:

“7.5 BULLETINS. A Bulletin is a written document prepared by the Architect/Engineer as a statement of changes in the scope of Work which may or may not change the Contract Amount or Time. The Contractor shall return the executed Bulletin to the Architect/Engineer on or before the date stated in the Bulletin stating his agreement to change the Scope of Work and any proposed adjustment to the Contract Amount and the Contract Time. All Bulletin items shall subsequently be recorded on a Change Order.”

8. ARTICLE 8 – TIME: No changes.

9. ARTICLE 9 – PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

After 9.2, add the following:

“9.2.1 Refer to Section 01 20 00 for detailed schedule of values requirements.”
9.3 APPLICATIONS FOR PAYMENT

9.3.1 Delete the first sentence and replace with the following:
“Submission of Application for Payment shall follow 9.6 of the Supplementary Conditions.

9.6 PROGRESS PAYMENTS

After 9.6.8 add the following sub-articles:

“9.6.9 Based upon Applications for Payment submitted to the Architect by the Contractor, the Owner shall make progress payment on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

9.6.9.1 The period covered by each Application for Payment shall be on the 25th day of the month.

9.6.9.2 Provided an Application for Payment is received by the Architect not later than the 25th day of a month, the Owner shall make payment to the Contractor not later than the 25th day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than 60 days after the Architect receives the Application for Payment.

9.6.9.3 Each Application for Payment shall be based upon the Schedule of Values submitted by the Contractor in accordance with the Contract Documents. The Schedule of Values shall allocate the entire Contract Sum among the various portions of the Work and be prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor’s Applications for Payment.

9.6.9.4 Applications for Payment shall indicate the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

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

The retainage shall be an amount equal to not more than 5% of the estimate until 50% of the work has been completed. At 50% completion, no additional amounts shall be retained except that at 50% completion or any time thereafter when the progress of the work is not satisfactory, additional amounts may be retained, but in no event shall the total retainage be more than 10% of the value of the work completed.

9.6.9.6 The progress payment amount determined in accordance with Paragraph 9.6 shall be further modified per Paragraph 9.6 of the Supplementary Conditions.

9.6.9.6.1 Add, upon Substantial Completion of the Work, retainage to remain at 5% of Contract Sum until the Contract is closed out. This amount MAY be reduced to a lower percentage or lump sum if agreed to by Owner, Contractor and A/E.

9.6.9.7 Reduction or limitation of retainage, if any, shall be per Paragraph 9.6 of the Supplementary Conditions.”
9.8 SUBSTANTIAL COMPLETION

After 9.8.5 add the following:

“9.8.6 Failure to reach final completion within 60 days from total Substantial Completion of the Project shall be cause to terminate the Contract and the Contractor's surety shall be notified accordingly.”

9.10 FINAL COMPLETION AND FINAL PAYMENT

Add to Subparagraph 9.10.1 the following clauses:

“.1 Upon completion of the Final Inspection if the Work is not acceptable and the Contract not fully performed, the AE will notify the Contractor, in writing, of all unfinished Work and fix the time within which the Contractor shall complete the items listed. Upon notification by the Contractor that the list of uncompleted items is complete, the AE will make a follow-up inspection trip.

.2 Time spent by the AE to follow-up on such unfinished Work to determine that the Contractor has fully performed the Contract shall be paid for by the Contractor on the basis of the AE's regular hourly rate schedule for supplementary services and reimbursable expenses as stated in the AE's agreement for services with the Owner.

.3 Payment for all such additional services required of the AE will be deducted from the balance due the Contractor, duly noted on the final Certificate for Payment and paid by the Owner directly to the AE.”

After 9.10.5, add the following:

“9.10.6 Refer to Section 01 78 00 for detailed Contract closeout procedures.”

10. ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY: No Changes.

11. ARTICLE 11 – INSURANCE AND BONDS

11.1 CONTRACTOR’S INSURANCE AND BONDS; Refer to “Section 00 74 00 Owner’s Instructions for Bonds and Insurance” for coverage requirements.

11.2 OWNER’S INSURANCE

Add 11.2.1.1 as follows:

“11.2.1.1 The Contractor shall provide and maintain Property Insurance to cover the deductible of the Owner’s property insurance in the amount of $500.00 of loss on any claim, or provide evidence satisfactory to the Owner that the Contractor shall pay for all such losses not covered by the Owner against the same peril as described for the Owner’s Property Insurance.”
12. ARTICLE 12 – UNCOVERING AND CORRECTION OF WORK:
After 12.2.2.1 add the following:

“12.2.2.2 Contractor shall correct defective Work within a two year period after Date of Substantial Completion. This time frame does not change or supercede specific manufacturer’s equipment or product warranty time frames.”

13. ARTICLE 13 – MISCELLANEOUS PROVISIONS: No Changes.
15. ARTICLE 15 – CLAIMS AND DISPUTES: No Changes.

END OF DOCUMENT 00 73 00
Payment Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:
(Name, legal status and address)

CONSTRUCTION CONTRACT
Date:

Amount:

Description:
(Name and location)

BOND
Date:
(Not earlier than Construction Contract Date)

Amount:

Modifications to this Bond: ☐ None ☐ See Section 18

CONTRACTOR AS PRINCIPAL
Company: ____________________________ (Corporate Seal)

SURETY
Company: ____________________________ (Corporate Seal)

Signature: ____________________________________________

Name ____________________________
and Title: ____________________________

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER: ____________________________

OWNER’S REPRESENTATIVE: ____________________________
(Architect, Engineer or other party:)

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

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.
§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety’s obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner’s property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety’s expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety’s obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

.2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant’s obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety’s expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety’s failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney’s fees the Claimant incurs hereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety’s total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney’s fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner’s priority to use the funds for the completion of the work.
§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions
§ 16.1 Claim. A written statement by the Claimant including at a minimum:
.1 the name of the Claimant;
.2 the name of the person for whom the labor was done, or materials or equipment furnished;
.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
.4 a brief description of the labor, materials or equipment furnished;
.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
.7 the total amount of previous payments received by the Claimant; and
.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms “labor, materials or equipment” that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor’s subcontractors, and all other items for which a mechanic’s lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL
Company: ____________________________ (Corporate Seal) Company: ____________________________ (Corporate Seal)

Signature: ____________________________
Name and Title: ____________________________
Address: ____________________________

Signature: ____________________________
Name and Title: ____________________________
Address: ____________________________
Performance Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:
(Name, legal status and address)

CONSTRUCTION CONTRACT
Date:
Amount:
Description:
(Name and location)

BOND
Date:
(Not earlier than Construction Contract Date)
Amount:
Modifications to this Bond:  □ None  □ See Section 16

CONTRACTOR AS PRINCIPAL
Company:
(Corporate Seal)

SURETY
Company:
(Corporate Seal)

Signature:  ____________________________
Name and Title:
(Any additional signatures appear on the last page of this Performance Bond)

FOR INFORMATION ONLY — Name, address and telephone
AGENT or BROKER:  ____________________________
OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party):

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.
Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

Init.  ____________________________
§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety’s obligation under this Bond shall arise after

.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor’s performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner’s notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety’s receipt of the Owner’s notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner’s right, if any, subsequently to declare a Contractor Default;

.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety’s obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety’s expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner’s concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner, or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.
§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
2. additional legal, design professional and delay costs resulting from the Contractor’s Default, and resulting from the actions or failure to act of the Surety under Section 5; and
3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety’s liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions
§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

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§ 16 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company:

(Signature)
Name and Title:
Address

(Surety)

Company:

(Signature)
Name and Title:
Address
WISCONSIN SALES AND USE TAX EXEMPTION CERTIFICATE

Check One  □ Single Purchase  □ Continuous

Purchaser’s Business Name  Purchaser’s Address

The above purchaser, whose signature appears on the reverse side of this form, claims exemption from Wisconsin state, county, baseball or football stadium, local exposition, and premier resort sales or use tax on the purchase, lease, license, or rental of tangible personal property, property under sec. 77.52(1)(b), items under sec. 77.52(1)(c), goods under sec. 77.52(1)(d), or taxable services, as indicated by the box(es) checked below.

I hereby certify that I am engaged in the business of selling, leasing, licensing, or renting: ____________________________________________________________

(Purchaser’s description of property, items, goods, or services sold by purchaser.)

Purchaser’s description of property or services purchased (itemize property, items, or goods purchased if “single purchase”):

________________________________________________________________________

Seller’s Name  Seller’s Address

REASON FOR EXEMPTION

□ Resale  (Enter purchaser’s seller’s permit or use tax certificate number)

Manufacturing and Biotechnology

□ Tangible personal property (TPP) or item under s.77.52(1)(b) that is used exclusively and directly by a manufacturer in manufacturing an article of TPP or items or property under s.77.52(1)(b) or (c) that is destined for sale and that becomes an ingredient or component part of the article of TPP or items or property under s.77.52(1)(b) or (c) destined for sale or is consumed or destroyed or loses its identity in manufacturing the article of TPP or items or property under s.77.52(1)(b) or (c) destined for sale.

□ Machines and specific processing equipment and repair parts or replacements thereof, exclusively and directly used by a manufacturer in manufacturing tangible personal property or items or property under s.77.52(1)(b) or (c) and safety attachments for those machines and equipment.

□ The repair, service, alteration, fitting, cleaning, painting, coating, towing, inspection, and maintenance of machines and specific processing equipment, that the above purchaser would be authorized to purchase without sales or use tax, at the time the service is performed. Tools used to repair exempt machines are not exempt.

□ Fuel and electricity consumed in manufacturing tangible personal property or items or property under s.77.52(1)(b) or (c) in this state.

Percent of fuel exempt: ________ %  Percent of electricity exempt: ________ %

□ Portion of the amount of fuel converted to steam for purposes of resale. Percent of fuel exempt: ________ %

□ Property used exclusively and directly in qualified research, by persons engaged in manufacturing at a building assessed under s. 70.995, by persons engaged primarily in biotechnology in Wisconsin, or a combined group member conducting qualified research for another combined group member that meets these requirements.

Farming  (To qualify for this exemption, the purchaser must use item(s) exclusively and directly in the business of farming, including dairy farming, agriculture, horticulture, floriculture, silviculture, or custom farming services.)

□ Tractors (except lawn and garden tractors), all-terrain vehicles (ATV) and farm machines, including accessories, attachments, and parts, lubricants, nonpowered equipment, and other tangible personal property or items or property under s.77.52(1)(b) or (c) that are used exclusively and directly, or are consumed or lose their identities in the business of farming. This includes services to the property and items above.

□ Feed, seeds for planting, plants, fertilizer, soil conditioners, sprays, pesticides, and fungicides.

□ Breeding and other livestock, poultry, and farm work stock.

□ Containers for fruits, vegetables, grain, hay, and silage (including containers used to transfer merchandise to customers), and plastic bags, sleeves, and sheeting used to store or cover hay and silage. Baling twine and baling wire.

□ Animal waste containers or component parts thereof (may only mark certificate as “Single Purchase”).

□ Animal bedding, medicine for farm livestock, and milk house supplies.
**Governmental Units and Other Exempt Entities**

- The United States and its unincorporated agencies and instrumentalities.
- Any federally recognized American Indian tribe or band in this state.
- Wisconsin state and local governmental units, including the State of Wisconsin or any agency thereof, Wisconsin counties, cities, villages, or towns, and Wisconsin public schools, school districts, universities, or technical college districts.
- Organizations organized and operated exclusively for religious, charitable, scientific, or educational purposes, or for the prevention of cruelty to children or animals. CES Number ______________________ (Required for Wisconsin organizations).

**Other**

- Containers and other packaging, packing, and shipping materials, used to transfer merchandise to customers of the purchaser.
- Trailers and accessories, attachments, parts, supplies, materials, and service for motor trucks, tractors, and trailers which are used exclusively in common or contract carriage under LC, IC, or MC No. (if applicable) ______________________.
- Machines and specific processing equipment used exclusively and directly in a fertilizer blending, feed milling, or grain drying operation, including repair parts, replacements, and safety attachments.
- Building materials acquired solely for and used solely in the construction or repair of holding structures used for weighing and dropping feed or fertilizer ingredients into a mixer or for storage of such grain, if such structures are used in a fertilizer blending, feed milling, or grain drying operation.
- Tangible personal property purchased by a person who is licensed to operate a commercial radio or television station in Wisconsin, if the property is used exclusively and directly in the origination or integration of various sources of program material for commercial radio or television transmissions that are generally available to the public free of charge without a subscription or service agreement.
- Fuel and electricity consumed in the origination or integration of various sources of program material for commercial radio or television transmissions that are generally available to the public free of charge without a subscription or service agreement.
  
  Percent of fuel exempt: ______ %
  Percent of electricity exempt: ______ %

  Tangible personal property and items, property and goods under s.77.52(1)(b), (c), and (d) to be resold by
  on my behalf where
  is registered to collect and remit sales tax to the Department of Revenue on such sales.

- Tangible personal property, property, items and goods under s.77.52(1)(b), (c), and (d), or services purchased by a Native American with enrollment # __________, who is enrolled with and resides on the __________ Reservation, where buyer will take possession of such property, items, goods, or services.

- Tangible personal property and items and property under s.77.52(1)(b) and (c) becoming a component of an industrial or municipal waste treatment facility, including replacement parts, chemicals, and supplies used or consumed in operating the facility. Caution: Do not check the "continuous" box at the top of page 1.

- Portion of the amount of electricity or natural gas used or consumed in an industrial waste treatment facility. (Percent of electricity or natural gas exempt ________ %)

- Electricity, natural gas, fuel oil, propane, coal, steam, corn, and wood (including wood pellets which are 100% wood) used for fuel for residential or farm use.

<table>
<thead>
<tr>
<th>% of Electricity Exempt</th>
<th>% of Natural Gas Exempt</th>
<th>% of Fuel Exempt</th>
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<tr>
<td>Residential</td>
<td>______ %</td>
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<tr>
<td>Farm</td>
<td>______ %</td>
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</table>

Address Delivered:

- Percent of printed advertising material solely for out-of-state use. ________ %
- Catalogs, and the envelopes in which the catalogs are mailed, that are designed to advertise and promote the sale of merchandise or to advertise the services of individual business firms.
- Computers and servers used primarily to store copies of the product that are sent to a digital printer, a plate-making machine, or a printing press or are used primarily in prepress or postpress activities, by persons whose NAICS code is 323111, 323117, or 323120.
- Purchases from out-of-state sellers of tangible personal property that are temporarily stored, remain idle, and not used in this state and that are then delivered and used solely outside this state, by persons whose NAICS code is 323111, 323117, or 323120.
- Other purchases exempted by law. (State items and exemption).

I hereby certify that if the item(s) being purchased are not used in an exempt manner, I will remit use tax on the purchase price at the time of first taxable use. I understand that failure to remit the use tax may result in a future liability that may include tax, interest, and penalty.

Signature of Purchaser
Print or Type Name
Title
Date
INSTRUCTIONS

This certificate may be used to claim exemption from Wisconsin state, county, baseball and football stadium, local exposition, and premier resort sales or use taxes.

Under the sales and use tax law, all receipts from sales of tangible personal property, property, items and goods under sec. 77.52(1)(b), (c), and (d), or taxable services are subject to the tax until the contrary is established. However, a seller who receives a fully completed exemption certificate no later than 90 days after the date of sale is relieved of any responsibility for collection or payment of the tax upon transactions covered by the certificate. A fully completed certificate is one which is completely filled in and indicates the reason for exemption.

RESALE: A purchaser using the resale exemption is attesting that the tangible personal property, property, items, or goods under sec. 77.52(1)(b), (c), or (d), or taxable services being purchased will be resold, leased, licensed, or rented. However, in the event any such property, items, or goods is used for any purpose other than retention, demonstration, or display while holding it for sale, lease, license, or rental in the regular course of business, the purchaser is required to report and pay the tax on the purchase of the property, item, or good.

The following purchasers may make purchases for resale even though they do not hold a Wisconsin seller’s permit or use tax certificate: (a) A wholesaler who only sells to other sellers for resale may insert “Wholesale only” in the space for the seller’s permit number; (b) A person who only sells or repairs exempt property, such as to a manufacturer or farmer, may insert “Exempt sales only”; (c) A nonprofit organization may insert “Exempt sales only” if its subsequent sales of the tangible personal property, property, items, or goods under sec. 77.52(1)(b), (c), or (d), or taxable services are exempt as occasional sales.

A seller is allowed to accept an exemption certificate from an out-of-state retailer claiming the resale exemption for tangible personal property and items, property, and goods under sec. 77.52(1)(b), (c) and (d), Wis. Stats., drop shipped to a Wisconsin location, regardless of whether or not the out-of-state retailer holds a Wisconsin seller’s permit. The out-of-state retailer’s permit number, if the other state issues one, and state should be listed on the exemption certificate. If the exemption certificate does not list the Wisconsin seller’s permit number or the out-of-state retailer’s permit number and state, to be fully complete and valid the exemption certificate must contain a statement indicating the out-of-state retailer is a seller that is not required to hold a permit.

A resale exemption may be granted if the purchaser is unable to ascertain at the time of purchase whether the property will be sold or will be used for some other purpose. If the buyer purchases an item without tax for resale, but uses the item, the buyer owes use tax on its purchase of the item.

MANUFACTURING: “Manufacturing” means the production by machinery of a new article of tangible personal property or items or property under sec. 77.52(1)(b) or (c) with a different form, use, and name from existing materials, by a process popularly regarded as manufacturing, and that begins with the conveying raw materials and supplies from plant inventory to the place where work is performed in the same plant and ends with conveying finished units of tangible personal property or items or property under sec. 77.52(1)(b) or (c) to the point of first storage in the same plant.

FARMING: This certificate may not be used by farmers to claim exemption for the purchase of motor vehicles or trailers for highway use, lawn or garden tractors, snowmobiles, or for items used for the personal convenience of the farmer. When claiming an exemption for an ATV which is also registered for public use, a written description including the percentages of time for personal and farm use, must be submitted with the ATV Registration Application.

The sales price from the sale of electricity, natural gas, and other fuels for use in farming are exempt all 12 months of the year. Farmers claiming this exemption should check the box for electricity and fuel located in the “Other” section.

This certificate cannot be used as an exemption for paying Wisconsin motor vehicle fuel tax.

GOVERNMENTAL UNITS AND OTHER EXEMPT ENTITIES:

A seller may accept exemption certificates from federal and Wisconsin governmental units and federally recognized American Indian tribes or bands in Wisconsin. Instead of obtaining an exemption certificate, a seller may (1) accept a purchase order from the governmental unit or tribe or band, or (2) record the governmental unit or tribe or band’s Certificate of Exempt Status (CES) number on its invoices. Governmental units of other countries and states are not exempt from Wisconsin sales tax.

The exemption for the United States and its unincorporated agencies and instrumentalities may also be claimed by any incorporated agency or instrumentality of the United States wholly owned by the United States or by a corporation wholly owned by the United States.

The exemption for Wisconsin governmental units and other exempt entities may be claimed by: Local Exposition District, Professional Baseball Park District, Professional Football Stadium District, UW Hospitals and Clinics Authority, Wisconsin Aerospace Authority, Health Insurance Risk-Sharing Plan Authority, Wisconsin Economic Development Authority, Fox River Navigational System Authority, public inland lake protection and rehabilitation districts, municipal public housing authorities, uptown business improvement districts, local cultural arts districts, county-city hospitals, sewerage commissions, metropolitan sewerage districts, or joint local water authorities.

Organizations holding a Certificate of Exempt Status (CES) number: Wisconsin organizations organized and operated exclusively for religious, charitable, scientific, or educational purposes, or for the prevention of cruelty to children or animals, may purchase products or services exempt from Wisconsin sales tax if the organization holds a CES number issued by the Wisconsin Department of Revenue. Wisconsin and federal governmental units, and any federally recognized American Indian tribe or band in Wisconsin, will also qualify for a CES.

A similar out-of-state organization, generally organized under sec. 501(c)(3) of the Internal Revenue Code, may purchase products or services exempt from Wisconsin sales tax even though it has not been issued a CES number. This exemption does not apply to out-of-state public schools, including public colleges and universities, and governmental units from other states.
Purchases (for lodging, meals, auto rental, etc.) by employees/representatives of exempt organizations performing organization business, are exempt from sales tax, provided 1) the retailer issues the billing or invoice in the name of the exempt organization, 2) the CES number is entered on the billing or invoice, and 3) the retailer retains a copy of that document.

OTHER:
Containers: This exemption applies regardless of whether or not the containers are returnable. Containers used by the purchaser only for storage or to transfer merchandise owned by the purchaser from one location to another do not qualify for the exemption.

Common or contract carriers: The exemption available to common or contract carriers for certain vehicles and repairs listed on this certificate applies only to those units used "exclusively" in such common or contract carriage. A carrier may qualify for the common or contract carriage exemption even if it does not hold a LC or IC number. The fact that a carrier holds a LC or IC number is not in itself a reason for exemption. A carrier may qualify for the common or contract carrier exemption even if it does not hold an LC or IC number.

Waste treatment facilities: The exemption applies to the sale of tangible personal property and items and property under sec. 77.52(1)(b) and (c) to a contractor for incorporation into real property which is part of an industrial or commercial waste treatment facility that qualifies for property tax exemption or a Wisconsin or federal governmental waste treatment facility.

Electricity, natural gas, fuel oil, coal, steam, corn, and wood (including wood pellets which are 100% wood) used for fuel:
- The sales price from the sale of electricity and natural gas for residential use during the months of November through April are exempt from sales and use tax.
- The sales price from sales of fuel oil, propane, coal, steam, corn, and wood (including wood pellets which are 100% wood) used for fuel sold for residential use are exempt from sales or use tax. Wood pellets are considered 100% wood even though the pellets may contain a small amount of binding material used to form the pellets.
- The sales price from the sale of fuel and electricity for use in farming are exempt all year.

A retailer of electricity, fuel, or natural gas shall have a signed exemption certificate for exempt sales for residential or farm use unless any of the following apply:
1. 100% of the electricity, fuel, or natural gas is for exempt use.
2. The sale is to an account which is properly classified as residential or farm pursuant to schedules which are filed for rate tariff with the Wisconsin Public Service Commission which are in force at the time of sale.
3. The sale is to an account which is properly classified as residential or farm for classification purposes as directed by the Federal Rural Electrification Administration.

"Farm use" means used in farming, including use in a tractor or other farm machines used directly in farming, in a furnace heating a farm building, in providing lighting in farm buildings, and use in operating motors of machines used directly in farming.

"Residential use" means use in a structure or portion of a structure which is a person's permanent principal residence. It does not include use in motor homes, travel trailers, other recreational vehicles, or transient accommodations. "Transient accommodations" means rooms or lodging available to the public for a fee for a continuous period of less than one month in a building such as a hotel, motel, inn, tourist home, tourist house or court, summer camp, resort lodge, or cabin.

Other purchases exempted by law include:
1. Printed material which is designed to advertise and promote the sale of merchandise, or to advertise the services of individual business firms, which printed material is purchased and stored for the purpose of subsequently transporting it outside the state by the purchaser for use thereafter solely outside the state.
2. Parts, supplies, or repairs for a school bus used exclusively as a contract carrier pursuant to a contract with a school or other organization.
3. Waste reduction and recycling machinery and equipment, including parts and repairs, which are exclusively and directly used for waste reduction and recycling activities.
4. Railway cars, locomotives, and other rolling stock used in railroad operations, or accessories, attachments, parts, lubricants, or fuel thereof.
5. Commercial vessels and barges of 50-ton burden or over engaged in interstate or foreign commerce or commercial fishing, and accessories, attachments, parts, and fuel thereof.
6. Fuel sold for use in motorboats that are regularly employed in carrying persons for hire for sport fishing in and upon the outlying waters, as defined in sec. 29.001(63), Wis. Stats., and the rivers and tributaries specified in sec. 29.2285(2) (a)1. and 2., Wis. Stats., if the owner and all operators are licensed under sec. 29.514, Wis. Stats., to operate the boat for that purpose.
7. A product whose power source is the wind, direct radiant energy received from the sun, or gas generated by the anaerobic digestion of animal manure and other agricultural waste, if the product produces at least 200 watts of alternating current or at least 600 British thermal units per day, but not including a product that is an uninterrupted power source that is designed primarily for computers.
8. Effective July 1, 2013, snowmaking and snow-grooming machines and equipment, including accessories, attachments, and parts for the machines and fuel and electricity used to operate such machines and equipment, that are used exclusively and directly for snowmaking at ski hills, ski slopes, and ski trails.
9. Effective July 1, 2013, advertising and promotional direct mail and printing services used to produce advertising and promotional direct mail.

SIGNATURE: For corporations, this form must be signed by an employee or officer of the corporation.

QUESTIONS: If you have questions, please contact us.

WISCONSIN DEPARTMENT OF REVENUE
Customer Service Bureau
PO Box 8949
Madison WI 53708-8949

Phone: (608) 266-2776
Fax: (608) 267-1030
Website: revenue.wi.gov

Wisconsin Department of Revenue
SECTION 00 74 00
INSTRUCTIONS FOR BONDS AND INSURANCE

PART 1: GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Owner’s Instructions for insurance and bonds.

1.02 RELATED REQUIREMENTS

A. Section 00 21 00 – Instructions to Bidders: Requirements for Bid Bond.

B. Section 00 72 00 General Conditions of the Contract for Construction, AIA A201.

C. Section 00 73 00 Supplementary Conditions.

1.03 INSTRUCTIONS FOR INSURANCE

A. Notification to Owner: The Contractor shall, in consultation with insurance provider, submit
documentation for the insurance coverages listed below.

B. Contractor’s Liability Insurance: Concerning the insurance referenced in Article 11 Insurance
and Bonds, Section 11.1 in AIA Document A201, 2017 edition, policy shall be written for the
following minimum limits or greater if required by law.

   1. Workers’ Compensation:
      a) State Statutory Limit
      b) Employer’s Liability: $500,000 per Accident.

   2. Comprehensive or Commercial General Liability (including Premises-Operations;
      Independent Contractors’ Protective; Products and Completed Operations; Broad
      Form Property Damage):
      a) Bodily Injury and Property Damage:
         $1,000,000 Combined Single Limit (CSL) Each Occurrence
         Minimum $2,000,000 Aggregate or Per Project Endorsement

   3. Contractual Liability:
      a) Bodily Injury and Property Damage:
      $1,000,000 Combined Single Limit (CSL) Each Occurrence
      Minimum $2,000,000 Aggregate or Per Project Endorsement

   4. Business Auto Liability (including owned, non-owned and hired vehicles):
      a) Bodily Injury and Property Damage:
      $1,000,000 Combined Single Limit (CSL) Each Occurrence
      Minimum $2,000,000 Aggregate or Per Project Endorsement

   5. Umbrella Excess Liability:
      $2,000,000 over primary insurance.
      Maximum self-insured retention of $25,000.

   6. The Owner and AE shall be named as additional insureds.

   7. If this insurance is written on the Comprehensive General Liability policy form, the Certificates
      shall be AIA Document G705, Certificate of Insurance. If this insurance is written on a
      Commercial General Liability policy form, ACORD form 25 will be acceptable.
1.04 INSTRUCTIONS FOR PERFORMANCE AND PAYMENT BOND

A. The Contractor shall furnish bonds as described below, covering the faithful performance of the Contract and the payments of all obligations arising thereunder. The bonds specified under this Article shall be issued by a bonding company licensed to do business in the state where the construction will take place.

B. Furnish both AIA A312 Performance Bond and AIA A312 Payment Bond, 2010 edition, each in the amount of 100% of the contract price.

C. Bond amounts shall not exceed the single bond limit for the Contractor’s bonding company as set forth in the Federal Register current as of the date.

D. The bonds shall be written with such sureties secured through the Contractor’s usual sources as may be agreeable to the parties. In addition, the sureties shall be authorized to conduct surety business in the state in which the Project is located, and the sureties and any reinsuring companies shall be listed in the current Department of the Treasury Circular No. 570 with an underwriting limitation equal to or greater than the penal sum of the bonds to be furnished.

E. The Contractor 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 attorney-in-fact’s power of attorney.

PART 2: PRODUCTS - Not Used.

PART 3: EXECUTION - Not Used.

END OF SECTION 00 74 00
PART 1 GENERAL

1.01 PROJECT
   A. Refer to Cover Sheet on Drawings for project title and location.
   B. Refer to 00 11 13 Advertisement for Bids for brief description of Project.

1.02 RELATED REQUIREMENTS
   A. Section 01 50 00 - Temporary Facilities: Requirements for temporary utilities.
   B. Section 01 70 00 - Administrative Requirements: Contract limits and protection of existing conditions.

1.03 CONTRACT DESCRIPTION
   A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 52 00 - Agreement Form.

1.04 PHASED CONSTRUCTION
   A. The Work shall be conducted in a single phase.

1.05 WORK BY OWNER
   A. Owner has awarded a contract for supply of HVAC equipment. Installation of said equipment shall be included in this Contract.
   B. Owner will enter into a separate Contract for commissioning of HVAC equipment with Tech Comm, Inc.
   C. Owner will enter into a separate Contract for HVAC Controls.
   D. Owner will enter into a separate Contract for the new modified bitumen roof system and alterations to existing EPDM roof. Coordinate with Garland Roofing. Contact is Brian Thompson, 612-710-0787.
   E. Items noted NIC (Not in Contract) will be supplied and installed by Owner.

1.06 MATERIALS OR EQUIPMENT SALVAGED AND REINSTALLED
   A. Identified overhead coiling door.
   B. Other items as identified on Drawings.

1.07 WORK BY OTHERS
   A. Items indicated "N.I.C." on the Project Drawings will be furnished and installed by others not a party to the Prime Contracts.

1.08 OWNER OCCUPANCY
   A. Owner intends to occupy the Project upon Substantial Completion.

1.09 CONTRACTOR USE OF SITE AND PREMISES
   A. Construction Operations: Limited to areas noted on Drawings.
      1. Mobilization will be allowed in Parking Lot K located on the east side of 8th St. with over flow available in Lot D to the north.
      2. Dumpster and Contractor access to building through May, may occur in the north parking lot. Once parking lot replacement begins dumpster location and access to be coordinated with Owner.
      3. No vehicular traffic allowed in south court yard.
   B. Provide access to and from site as required by law and by Owner:
      1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
      2. Do not obstruct roadways, sidewalks, or other public ways without permit.
   C. Time Restrictions:
      1. Work on the Project shall be done during normal working hours. If at any time during construction it becomes necessary to accelerate the Work in order to meet completion dates for portions or all of the Work, all trades shall work overtime at no additional cost to Owner.
Utility Outages and Shutdown:
1. Notify Owner within 48 hours of necessary interruptions of services including, but not limited to: HVAC systems, water service (hot & cold), electrical service, communications systems.
2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
3. Prevent accidental disruption of utility services to other facilities.

1.10 CONSTRUCTION SCHEDULE
A. Date of Commencement of the Work: May 11, 2020
B. Date of Substantial Completion: August 21, 2020
C. Final Completion: The completion of all Work according to the contract Documents, approved by the AE and accepted by the Owner shall be within 30 days after the Date of Substantial Completion.
D. Exceptions: The only exceptions to the above completion dates are delay or termination because of a national emergency and/or extension of time for completion claimed and allowed according to the General Conditions and/or Supplementary Conditions

1.11 WORK SEQUENCE
A. Coordinate construction schedule and operations with Architect.

END OF SECTION
SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Procedures for preparation and submittal of applications for progress payments.
   B. Documentation of changes in Contract Sum and Contract Time.
   C. Change order procedures.
   D. Correlation of Contractor submittals based on changes.
   E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS
   A. Document 00 52 13 - Agreement Forms AIA-A101: Contract Sum, payment period.
   B. Section 00 72 00 - General Conditions and Document 00 73 00 - Supplementary Conditions: Additional requirements for progress payments, final payment, changes in the Work.
   C. Section 00 73 00 - Supplementary Conditions: Percentage allowances for Contractor's overhead and profit.
   D. Document 00 73 00 - Supplementary Conditions: Dates for applications for payment.

1.03 SCHEDULE OF VALUES
   A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
   B. Forms filled out by hand will not be accepted.
   C. At least 10 days prior to submission of the first Application for Payment, secure A/E's approval of the schedule of values required to be submitted under 9.2 of the General Conditions.
   D. Base requests for payment on the approved schedule of values.
   E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Dollar value shall be rounded to the nearest ten dollars ($10).
   F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS
   A. Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates of 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.
   B. Payment Period: One calendar month time frame.
   C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
   D. Forms filled out by hand will not be accepted.
   E. Provided an Application for Payment per 9.6 of 00 73 00 Supplementary Conditions.
   F. Each Application for Payment shall be based upon the Schedule of Values submitted in accordance with the Contract Documents. The Schedule of Values shall allocate the entire Contract Sum among the various portions of the Work and be prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This Schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Applications for Payment.
   G. The Applications for Payment shall indicate the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.
   H. Execute certification by signature of authorized officer.
   I. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
   J. The progress payment amount determined in accordance with 00 73 00 Supplementary Conditions, Paragraph 9.6.
   K. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
L. Submit one electronic and three hard-copies of each Application for Payment.

M. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 01 30 00.
   2. Construction progress schedule, revised and current as specified in Section 01 30 00.
   3. Current construction photographs specified in Section 01 30 00.

N. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 PRODUCT HANDLING

A. Maintain a "Register of Bulletins and Change Orders" at the job site, accurately reflecting current status of all pertinent data.

B. Make the Register available for review upon request.

1.06 PROCESSING CHANGES INITIATED BY THE OWNER AND/OR AE

A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.

B. Should the Owner contemplate making a change in the Work or a change in the Contract Time of Completion, the Architect/Engineer, upon Owner direction, will issue a "Bulletin" to the Contractor.
   1. Bulletins will be dated and will be numbered in sequence.
   2. The Bulletin will describe the contemplated change.
      a. Promptly advise Architect/Engineer as to credit or cost and time required proposed for the described change. This is not an authorization to proceed with the change.

C. If the Contractor has been directed by Architect/Engineer to make the described change in the Work at no change in the Contract Sum and no change in the Contract Time of Completion, but the Contractor wishes to make a claim for one or both of such changes, the Contractor shall proceed with the change and shall notify the Architect/Engineer as provided for under Article 7 of the General Conditions.

D. If the Contractor has been directed by Architect/Engineer to make the described change subject to later determination of cost or credit in accordance with Article 7 of the General Conditions, the Contractor shall:
   1. Take such measures as needed to make the change;
   2. Consult with Architect/Engineer and reach agreement on the most appropriate method for determining credit or cost for the change.

1.07 PROCESSING CHANGES INITIATED BY CONTRACTOR

A. Should the Contractor discover a discrepancy among the Contract Documents, a concealed condition or other cause for suggesting a change in the Work, a change in the Contract Sum, or a change in the Contract Time of Completion, he shall notify Architect/Engineer as required by pertinent provisions of the Contract Documents.

B. Upon agreement by Architect/Engineer that there is reasonable cause to consider the Contractor's proposed change, Architect/Engineer will issue a Bulletin in accordance with the provisions described in Article 1.06 above.

1.08 PROCESSING OF BULLETINS

A. Make written reply to Architect/Engineer in response to each Bulletin by date stated on the Bulletin:
   1. State proposed change in the Contract Sum, if any.
   2. State proposed change in the Contract Time of Completion, if any.
   3. Clearly describe other changes in the Work required by the proposed change, or desirable therewith, if any.
   4. Include full backup data such as subcontractor's letter of proposal or similar information.

B. When cost or credit for the proposed change has been agreed upon by the Owner and the Contractor, or the Owner has directed that cost or credit be determined in accordance with provisions of Article 7 of the General conditions, A/E will notify contractor in writing. A formal Change Order will be initiated and executed at the time of completion of the Contract, or at a time when the payment for work completed is due. All approved Bulletins previously not incorporated into the Contract by a Change Order, shall be combined into a Change Order to adjust the final Contract Sum to compensate for all Changes in the Work to date.
1.09 PROCESSING CHANGE ORDERS

A. Change Orders will be dated and will be numbered in sequence.

B. The Change Order will describe the change or changes, will refer to the Bulletin or Bulletins involved, and will be endorsed by Architect/Engineer and signed by the Contractor and the Owner.

C. Architect/Engineer will issue three copies of each Change Order.
   1. The Contractor promptly shall sign all three copies and return all copies to Architect/Engineer.
   2. Architect/Engineer shall forward the Change Order to the Owner for his signature. Upon approval, he shall distribute two fully executed copies of the Change Order to Architect/Engineer. A/E to distribute one to the Contractor.

D. Substantiation of Costs: Provide full information required for evaluation.
   1. On request, provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. Support each claim for additional costs with additional information:
      a. Origin and date of claim.
      b. Dates and times work was performed, and by whom.
      c. Time records and wage rates paid.
      d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
   3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

E. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

F. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

G. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

H. Promptly enter changes in Project Record Documents.

1.10 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 01 70 00 and as outlined in paragraph 9.10 of the Supplementary Conditions.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Description of Alternates.

1.02 RELATED REQUIREMENTS
A. Document 00 21 13 - Instructions to Bidders: Instructions for preparation of pricing for Alternates.

1.03 DESCRIPTION
A. Conditions of the Contract and pertinent portions of Sections in Division One of this Project Manual, apply to the Work of this Section as fully as though repeated herein.
B. This Section describes the alternatives to the project. Refer to the Product/Execution Articles of the Contract Documents for information pertaining to the work of each alternate.
C. Each proposal under an alternate shall include all incidental work and all adjustments necessary to accommodate the changes. All work shall meet the requirements of the Contract Documents.
D. Each alternate proposal shall be submitted as an individual cost for the particular alternate and shall be proposed under the premise that no other alternates have been accepted. Should the work of an alternate called for by the Bid Form not affect the cost of the work, "No Change" shall be stated.
E. Owner may, at his option, vary the scope of the work by authorizing alternates which will add to the work, deduct from the work or substitute materials, equipment or methods.
F. Immediately following Award of Contract, awarded Contractor shall prepare and distribute to each party involved, notification of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for consideration at a later date. Include a complete description of negotiated modifications to alternates, if any.

1.04 ACCEPTANCE OF ALTERNATES
A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

1.05 SCHEDULE OF ALTERNATES
A. Alternate No. 1: Parking Lot & Site work;
   1. The following work shall be priced under Alternate No. 1: State the amount to be added to the base bid for all site work. Work includes, but is not limited to the reconstruction of the parking lot, concrete walks and paving, site lighting, infilling existing loading dock, storm water retention, sod/seeding and plantings. Alternate No. 1 Work is contingent upon Wisconsin Technical College State Board approval and will become a separate contract upon approval. Excavation for the structure at the tower addition shall be included in Alternate Number 3 work.

B. Alternate No. 2: HVAC
   1. The following work shall be priced under Alternate No. 2: State the amount to be added to the base bid to construct all HVAC work in the existing building and the new vestibule tower addition. Work includes, but is not limited to a new roof top unit for the office area and modification to the existing system for the remaining remodeled areas. Alternate No. 2 Work is contingent upon Wisconsin Technical College State Board approval and will become a separate contract upon approval.
C. Alternate No. 3: Exterior Renovation & Addition:
   1. The following work shall be priced under Alternate No. 3: State the amount to be added to the base bid for the construction of all exterior renovation work and the new tower vestibule addition. Work includes, but is not limited to removal of identified exterior walls, structural steel for wall support, excavation and foundation for new vestibule tower construction, new wall construction at removed locations including doors and windows, paint, brick and rain screen metal panel system. Alternate No. 3 Work is contingent upon Wisconsin Technical College State Board approval and will become a separate contract upon approval.

D. Alternate No. 4: Wall Removal:
   1. The following work shall be priced under Alternate No. 4: State the amount to be added to or deducted from the base bid to remove Wall Type D7, D15 and D1, doors and electrical conduit and boxes shown between rooms Lounge 101 and Office 102 and perimeter of Plbg Lab 138. Hardware for the doors, plumbing piping and electrical wiring shall remain in base bid. The Owner is contracting separately for a prefabricated wall system. There will be a chase available for plumbing piping and electrical conduit and boxes will be roughed in. At 101/102, Wall Type D4 will be constructed above the prefabricated wall in lieu of Base Bid Wall Type D7 and subsequent cost difference shall be reflected in Alternate Bid. At Room 138 the wood framed walls being replaced are 8 feet high. Install the 6 x 6 wood post in the corner with headers in each direction to adjacent walls as described on 3A100 and subsequent cost difference shall be reflected in Alternate Bid.

E. Alternate No. 5: Electrical Panel Replacement:
   1. The following work shall be priced under Alternate No. 5: State the amount to be added to the base bid to complete the following:
      a. Disconnect, remove and dispose of existing panelboards ‘LA1’ and ‘LA2’ and replace with Square ‘D’ panelboards as noted on drawings and as specified. Disconnect, remove and dispose of existing 112.5 KVA transformer and replace with new as noted on drawings and as specified.
      b. Disconnect, remove and dispose of existing panelboards ‘LB1’ and ‘LB2’ and replace with Square ‘D’ panelboards as noted on drawings and as specified. Disconnect, remove and dispose of existing 75.0 KVA transformer and replace with new 112.5 KVA transformer as noted on drawings and as specified.
      c. Disconnect, remove and dispose of existing panelboards ‘HA’ and ‘HB’ and replace with Square ‘D’ panelboards as noted on drawings and as specified.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS
   A. Section 00 22 13 - Supplementary Instructions to Bidders: Substitution process during bidding.
   B. Section 01 30 00 - Administrative Requirements: Submittal procedures, coordination.
   C. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS
   A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
      1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
         a. Unavailability.
         b. Regulatory changes.
      2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
         a. Substitution requests offering advantages solely to the Contractor will not be considered without a fair credit being offered to the Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS
   A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
      1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
      2. Agrees to provide the same warranty for the substitution as for the specified product.
      3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
      4. Waives claims for additional costs or time extension that may subsequently become apparent.
      5. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
   B. A Substitution Request for specified installer constitutes a representation that the submitter:
      1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
   C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
      1. Note explicitly any non-compliant characteristics.
   D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
      1. No specific form is required. Contractor's Substitution Request documentation must include the following:
         a. Project Information:
            1) Official project name and number, and any additional required identifiers established in Contract Documents.
         b. Substitution Request Information:
            1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
            2) Indication of whether the substitution is for cause or convenience.
            3) Issue date.
            4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
5) Description of Substitution.
6) Reason why the specified item cannot be provided.
7) Differences between proposed substitution and specified item.
8) Description of how proposed substitution affects other parts of work.

   c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
      1) Physical characteristics.
      2) In-service performance.
      3) Expected durability.
      4) Visual effect.
      5) Warranties.
      6) Other salient features and requirements.
7) Include, as appropriate or requested, the following types of documentation:
       (a) Product Data:
       (b) Samples.
       (c) Certificates, test, reports or similar qualification data.
       (d) Drawings, when required to show impact on adjacent construction elements.

d. Impact of Substitution:
   1) Savings to Owner for accepting substitution.
   2) Change to Contract Time due to accepting substitution.

E. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT
   A. Section 00 22 13 Supplementary Instructions to Bidders describes substitution process during bidding and specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.
      1. Bidder's Choice Substitution described for use in Bid procedure.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION
   A. Architect will consider requests for substitutions only within 15 days after date of Agreement.
   B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
   C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
      1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
      2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
      3. Bear the costs engendered by proposed substitution of:
         a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
   D. Substitutions will not be considered under one or more of the following circumstances:
      1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
      2. Without a separate written request.
      3. When acceptance will require revisions to Contract Documents.
3.04 RESOLUTION
   A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
   B. Architect will notify Contractor in writing of decision to accept or reject request.
      1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE
   A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES
   A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

END OF SECTION
PART 1 GENERAL
1.01 SECTION INCLUDES
   A. General administrative requirements.
   B. Electronic document submittal service.
   C. Preconstruction meeting.
   D. Progress meetings.
   E. Construction progress schedule.
   F. Progress photographs.
   G. Coordination drawings.
   H. Submittals for review, information, and project closeout.
   I. Number of copies of submittals.
   J. Requests for Interpretation (RFI) procedures.
   K. Submittal procedures.

1.02 RELATED REQUIREMENTS
   A. Section 01 25 00 - Substitution Procedures
   B. Section 01 40 00 - Quality Requirements: Testing reports
   C. Section 01 60 00 - Product Requirements: General product requirements.
   D. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
   E. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS
   A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
   B. Make the following types of submittals to Architect:
      1. Requests for Interpretation (RFI).
      2. Requests for substitution.
      3. Shop drawings, product data, and samples.
      4. Test and inspection reports.
      5. Design data.
      6. Manufacturer's instructions and field reports.
      7. Applications for payment and change order requests.
      8. Progress schedules.
      9. Coordination drawings.
      10. Correction Punch List and Final Correction Punch List for Substantial Completion.
      11. Closeout submittals.

1.04 PROJECT COORDINATOR
   A. Project Coordinator: Contractors jobsite superintendent.
   B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for equipment access, traffic, and parking facilities.
   C. During construction, coordinate use of site and facilities through the Project Coordinator.
   D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
   E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
   F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
G. Make the following types of submittals to Architect through the Project Coordinator:
   1. Requests for Interpretation.
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor and Architect are required to use this service.
   3. It is Contractor's responsibility to submit documents in allowable format.
   4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
   5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
   7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
   8. Physical samples or color charts required for color selection shall be scanned into PDF format and submitted for approval via the Electronic Document Submittal Service.

B. Submittal Service: The selected service is:
   1. Sharefile.

C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Architect will schedule a meeting within 10 working days after Notice of Award.

B. Attendance Required:
   1. Owner.
   3. Contractor.
   4. Major subcontractors.
   5. Architect/Engineer will advise other interested parties, and request their attendance.
C. Agenda:
1. Organizational arrangement of Contractor's forces and personnel, and those of subcontractors, materials suppliers, and Architect/Engineer.
2. Channels and procedures for communication.
3. Construction schedule, including sequence of critical work.
4. Coordination of separate contract work, if any.
7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.

D. Architect will conduct meeting, record and distribute minutes.

3.03 PROGRESS MEETINGS
A. Meetings to be held throughout progress of the Work at maximum monthly intervals.
B. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record and distribute minutes.
C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.
6. Assign the same person or persons to represent the Contractor at project meetings throughout progress of the Work.
7. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspect of the Work is involved.
D. Minimum Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to work.
E. Revisions to minutes
1. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting, they will be accepted as properly stating the activities and decisions of the meeting.
2. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
3. Challenge to minutes shall be settled as priority portion of "old business" at the next regularly scheduled meeting.

3.04 CONSTRUCTION PROGRESS SCHEDULE
A. Within 7 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
C. Within 7 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 7 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit updated schedule periodically as required to reflect progress made and remaining work to achieve contractual completion date.

3.05 PHOTOGRAPHS

A. Take photographs as evidence of existing project conditions as follows:
   1. Interior views: Verify conditions of adjacent surfaces and finish conditions for future verification.
   2. Exterior views: Verify conditions of adjacent items (i.e. sidewalks, paving, sod, walls etc.) for future verification.

B. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.

3.06 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Review drawings prior to submission to Architect.

3.07 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
      b. Do not forward requests which solely require internal coordination between subcontractors.
   2. Prepare in a format and with content acceptable to Architect.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents (Drawings, Addendums and Specifications) to confirm that information sufficient for their interpretation is definitely not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 01 25 00 Substitution Procedures)
      d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
   3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.

E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
   1. Official Project name and number, and any additional required identifiers established in Contract Documents.
   2. Owner's, Architect's, and Contractor's names.
   3. Discrete and consecutive RFI number, and descriptive subject/title.
   4. Issue date, and requested reply date.
   5. Contractor shall confirm that their research of the issue has included review of both the Project Drawings and Specification Manual.
   6. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
   7. Annotations: Field dimensions and/or description of conditions which have engendered the request.
   8. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
   1. Indicate current status of every RFI. Update log promptly and on a regular basis.
   2. Note dates of when each request is made, and when a response is received.
   3. Highlight items requiring priority or expedited response.
   4. Highlight items for which a timely response has not been received to date.
   5. Identify and include improper or frivolous RFIs.

H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 1:00 p.m. will be considered as having been received on the following regular working day.
   1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
   1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
   2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
   3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
   4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.08 SUBMITTAL SCHEDULE (LOG)

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Submit at the same time as the preliminary schedule.
   2. Coordinate with Contractor's construction schedule and schedule of values.
   3. Format schedule to allow tracking of status of submittals throughout duration of construction.
   4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
   a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.09 SUBMITTALS FOR REVIEW

A. Submittals shall be made identifying Document or Section Number and Title. Each item shall be identified separately on the transmittal.

B. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

C. Responsible Contractor/Subcontractor shall review submittals prior to submittal to Architect.
   1. Submittals shall be stamped as reviewed, with date and comments as required.

D. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

E. Samples will be reviewed for aesthetic, color, or finish selection.

F. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

C. Where contents of submitted product data include data not pertinent to the submittal, clearly indicate which portion of the contents is being submitted for review.

D. Within 30 days after notification of selection for award of contract, provide a listing of suppliers and manufacturers, include their address, phone number, and the portions of work which they will perform.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.12 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
B. Hard Copy Documents for Review: (If PDF format is not possible)
   1. Small Size Sheets, Not Larger Than 8-1/2 by 11 inches: Submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.
   2. Larger Sheets, Not Larger Than 36 by 48 inches: Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.
   3. Make to a scale sufficiently large to show all pertinent aspects of the item and its method of connection.
   4. Printing and distribution of review Shop Drawings for AE's use will be by AE. Contractor: Make and distribute all copies required for his purposes.
   5. Shop Drawings shall be prepared specifically for this Project. No reproduction of AE's drawings will be accepted.
   6. Hard Copy Documents for product data Information: Submit number of copies required to be returned plus two copies which will be retained by the A/E.

C. Extra Copies at Project Closeout: See Section 01 78 00.

3.13 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a separate transmittal for each item.
   2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   3. Transmit using approved form.
   4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   6. 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 in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      a. Deliver submittals to Architect at business address.
   8. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 10 days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 5 days.
   9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   10. Provide space for Contractor and Architect review stamps.
   11. When revised for resubmission, identify all changes made since previous submission.
   12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
   13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
   14. Submittals not requested will not be recognized or processed.
   15. Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the Contract Completion date.

B. Product Data Procedures:
   1. Submit only information required by individual specification sections.
   2. Collect required information into a single submittal.
   3. Submit concurrently with related shop drawing submittal.
   4. Do not submit (Material) Safety Data Sheets for materials or products.
C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.
4. In situations specifically so approved by AE, AE's retained Sample may be used in the construction as one of the installed items.
5. Unless the precise color and pattern is specifically described in the Contract Documents, and whenever a choice of color or pattern is available in a specified product, submit accurate color and pattern charts to AE for review and selection.

E. Reviewing and conditional approval are only for conformance with the design concept of the Project and compliance with the information given in the Contract Documents.

F. Conditions of approval: The Contractor is responsible for dimensions to be confirmed and correlated at the site; for information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction and for coordination of the Work of all trades. Corrections or comments made on this shop drawing submittal do not relieve the Contractor from compliance with requirements of Contract Documents.

G. Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the Contract Completion date.

3.14 SUBMITTAL REVIEW
A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
   a. "Approved", or language with same legal meaning.
   b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
      1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
   c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
      1) Resubmit corrected item, with review notations acknowledged and incorporated.
      2) Resubmit separately, or as part of project record documents.
      2) Non-responsive resubmittals may be rejected.
2. Not Authorizing fabrication, delivery, and installation:
   a. "Revise and Resubmit".
      1) Resubmit revised item, with review notations acknowledged and incorporated.
      2) Non-responsive resubmittals may be rejected.
   b. "Rejected".
      1) Submit item complying with requirements of Contract Documents.
E. Architect's and consultants' actions on items submitted for information:
   1. Items for which no action was taken:  
      a. "Received" - to notify the Contractor that the submittal has been received for record only.
   2. Items for which action was taken:  
      a. "Reviewed" - no further action is required from Contractor.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Submittals.
B. Testing agencies and services.
C. Control of installation.
D. Tolerances.
E. Manufacturers' field services.
F. Defect Assessment.

1.02 RELATED REQUIREMENTS
A. Document 00 72 00 - General Conditions: Inspections and approvals required by public authorities.
B. Section 01 30 00 - Administrative Requirements: Submittal procedures.
C. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.
   2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
   2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit report in duplicate within 30 days of observation to Architect for information.
   2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.05 CONFLICTING REQUIREMENTS
A. If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but indicated as equal to the Architect for a decision.

1.06 TESTING AND INSPECTION AGENCIES AND SERVICES
A. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
C. Contractor Employed Agency:
   2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
   3. Laboratory: Authorized to operate in the State in which the Project is located.
   4. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION
3.01 CONTROL OF INSTALLATION
A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
B. Comply with manufacturers' instructions, including each step in sequence.
C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
E. Have work performed by persons qualified to produce required and specified quality.
F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.
3.02 TOLERANCES
A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
C. Adjust products to appropriate dimensions; position before securing products in place.

3.03 TESTING AND INSPECTION
A. See individual specification sections for testing required.
B. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel and required equipment at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Submit reports of all tests/inspections specified. Test results and reports shall be furnished simultaneously to the Architect/Engineer (1 copy) and the General Contractor (1 copy) within one week of testing.
C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.
D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.04 MANUFACTURERS' 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, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
3.05 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.
B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION
SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Temporary utilities.
B. Temporary telecommunications services.
C. Temporary sanitary facilities.
D. Temporary Controls: Barriers, enclosures, fencing, and shoring.
E. Security requirements.
F. Vehicular access and parking.
G. Field offices.

1.02 RELATED REQUIREMENTS
A. Section 01 10 00 - Summary of the Work: Limitations on utility interruptions.
B. Section 01 70 00 - Execution and Closeout Requirements: Instructions for protection of floors and finished work.
C. Section 01 70 00 - Execution and Closeout Requirements: Contract limits and protection of existing site conditions.

1.03 EXISTING SERVICES AND UTILITIES
A. Maintain existing services and utilities in use at all times during construction. Provide and pay for temporary connections or devices when necessary to avoid interruptions of such services and utilities, and remove same when no longer needed.

1.04 TEMPORARY UTILITIES
A. Water:
1. Use Owners existing water service. Provide any modifications at contractor's expense. Owner to pay for water used.
2. Each contractor shall provide their own hoses.
3. Drinking Water: The Contractor shall provide drinking water for all persons on the Project during construction.
4. Use trigger-operated nozzles for water hoses, to avoid waste of water.
B. Electricity:
1. Use the Owners existing electrical service.
2. The Owner will furnish all electricity expended to complete construction at no cost to Contractor. Where required power requirements are not met with Owner's available service, Contractor shall provide necessary portable power to meet Project needs.

1.05 TEMPORARY VENTILATION
A. Provide ventilation as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature and humidity.
B. Provide adequate forced ventilation of enclosed areas for curing of installed materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases.

1.06 TELEPHONE AND INTERNET SERVICE
A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
B. Telecommunications services shall include:
1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
2. Telephone Land Lines or Cell Phone: One line, minimum; one handset per line.
3. Internet Connections: Minimum of one; DSL modem or faster.
4. Email: Account/address reserved for project use.
5. Contractor option to have internet and email service at their main office.
1.07 TEMPORARY SANITARY FACILITIES
   A. General Contractor shall provide and maintain temporary toilet facilities for use by all trades during the construction period. Such toilet facilities shall be sanitary, weathertight, painted, and complete with privacy enclosure, self-closing door and appropriate hardware.
   B. When plumbing services are available in the Project building, use of those facilities shall be permitted.
   C. General Contractor shall keep temporary toilet facilities clean and supplied with toilet paper at all times. Maintain the facilities according to requirements of local and state health and sanitation authorities.
   D. Maintain daily in clean and sanitary condition.
   E. At end of construction, return facilities to same or better condition as originally found.

1.08 BARRIERS
   A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public and to protect existing facilities and adjacent properties from damage from construction operations.
   B. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.09 FENCING
   A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.10 EXTERIOR ENCLOSURES
   A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
   B. For the building proper, Contractor shall provide suitable protection at holes through roof and floors, at openings through walls where a hazard exists and shall provide visual barriers at installed glass.
   C. Roof is currently under warranty. Roof penetration and flashing repair work shall be completed by the contractor providing the warranty. If original contractor not available use a certified contractor approved by roof system manufacturer.
   D. Do not subject roofs to traffic and do not use for storage purposes. If work is required on roof, protect roofing surface.

1.11 TEMPORARY SHORING
   A. Temporary Shoring
      1. Provide temporary shoring of load bearing structure where new openings are cut in load bearing walls, floors or ceilings. When required, Contractor shall provide services of a structural engineer registered in the state where work is performed, for design of shoring. Use means and methods to prevent damage to floors and adjacent finished surfaces. Repair adjacent construction and finishes damaged during removal work.

1.12 SECURITY
   A. Take precautions against fire and comply fully with requirements of insurance authorities and regulations of the local fire department.
   B. Remove combustible refuse and dispose in an approved manner off the Project Site. Burning refuse on the Project Site shall not be permitted. Do not store combustible materials or supplies in areas where concrete forms are still in place. Limit materials storage to completely fireproof areas. When storing outside keep at least 10 feet away from any building.
   C. During entire construction period, provide fire extinguishers of the types, sizes, quantity and locations effective for use by all trades to extinguish fires in the construction area(s), as defined in NFPA publication No. 10 but no less than the following:
      1. Type A at locations of low potential for fires caused by either electrical hazards or grease-oil-flammable liquids.
      2. Type ABC dry chemical at other locations, including but not limited to each workshop and each material storage shed.
D. Post warning and quick-use instructions at each extinguisher location and instruct all personnel upon first arrival at the Project Site in the proper use of fire extinguishers and fire related procedures. Post the local fire department call number on each telephone instrument at the Project Site. Post "No Smoking" signs in areas of unusual hazard.
E. Do not relax fire protection precautions during Work interruptions such as strikes or other reasons.
F. Provide and maintain barricades with appropriate lighting to identify excavations or stored materials placed on any public street, highway or other public ground. Conform to requirements of the local governing authority.
G. For the building proper, provide suitable protection at openings through roof and floors, and at openings through walls where a hazard exists, such as man-sized openings within three feet of the floor, and provide visual barriers at installed glass but do not use tape or markings applied directly to the glass surface.
H. Be responsible to maintain complete security of the building at all times during the entire period of the Work of the Project.

1.13 MOISTURE CONTROL
A. Each Contractor: Carry on construction work in manner that will direct surface water away from new construction and off the project Site, away from adjoining property.
B. General Contractor shall be responsible for pumping of building excavations as a part of the work of the General construction Contract without extra compensation. Pumping of other than building excavations shall be the responsibility of the contractor doing the work.
C. During process of completing building weatherproof enclosure contractors shall protect materials and areas of work susceptible to moisture damage. Installation of wet or moisture damaged materials is prohibited.

1.14 VEHICULAR ACCESS AND PARKING
A. Provide and maintain all required access to the Work from paved areas and other routes, in strict accordance with Owners requirements. Do not obstruct existing service drives and parking lots with equipment, materials and/or vehicles. Keep accessible for Owner's use at all times.
B. Contractors and their employees will be allowed to park vehicles in area designated by Owner.
C. Coordinate access and haul routes with governing authorities and Owner.
D. Provide and maintain access to fire hydrants, free of obstructions.
E. Provide means of removing mud from vehicle wheels before entering streets.

1.15 WASTE REMOVAL
A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
B. Provide containers with lids. Remove trash from site weekly.
C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.16 MATERIALS HANDLING AT PROJECT SITE
A. Each Contractor: Provide suitable storage facilities for own materials at the Project Site within the limits of construction, provide and maintain staging, scaffolding and the like, tools and equipment for the erection and completion of own work and remove all upon completion.
B. Each Contractor: Protect and preserve own materials, products and equipment stored at Project Site. Materials such as wood, steel, cement, and plasters shall not be piled directly on the ground. Protective coverings shall be watertight and substantial to prevent blowing away. Confine storage of materials, sheds and other apparatus to areas designated for such purposes.
C. During the course of construction, do not place construction materials on any structural plane or member such as a floor area, beam or column, in any manner, group or arrangement which exceeds the design live load of such structural plane or member.
1.17 FIRST AID
   A. Each Contractor: Provide and maintain first aid supplies and equipment in quantity and content commensurate with size of Project and type of construction work, for the use of each Contractor's personnel. Advise all personnel of the location of first aid supplies.

1.18 FIELD OFFICES
   A. Provide space in the Welding area for Project meetings, with table and chairs to accommodate 8 persons.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. General product requirements.
   B. Transportation, handling, storage and protection.
   C. Product option requirements.
   D. Substitution limitations.
   E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS
   A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
   B. Section 01 40 00 - Quality Requirements: Product quality monitoring.

1.03 REFERENCE STANDARDS
   A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
   A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
   B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
   C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
      1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS
   A. Provide new products unless specifically required or permitted by Contract Documents.
   B. Use of products having any of the following characteristics is not permitted:
      1. Made using or containing CFC's or HCFC's.
      2. Made of wood from newly cut old growth timber.

2.02 PRODUCT OPTIONS
   A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
   B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
   C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS
   A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS
A. See Section 01 25 00 - Substitution Procedures.

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

3.03 STORAGE AND PROTECTION
A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.
B. Store and protect products in accordance with manufacturers’ instructions.
C. Store with seals and labels intact and legible.
D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
E. For exterior storage of fabricated products, place on sloped supports above ground.
F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
G. Comply with manufacturer's warranty conditions, if any.
H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
I. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
J. Prevent contact with material that may cause corrosion, discoloration, or staining.
K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION
DOCUMENT 01 63 00

SUBSTITUTION REQUEST FORM

TO: Michelle Maland (Project Architect)
HSR ASSOCIATES, INC.
100 Milwaukee Street
La Crosse, WI 54603
Phone: (608) 784-1830
Fax: (608) 782-5844
Email: mmaland@hsrassociates.com
Project: Western Technical College Apprenticeship Center Remodel
HSR Project Number: 19021

SPECIFIED ITEM___________________________________ SECTION ________________
The undersigned requests consideration of the following

PROPOSED SUBSTITUTION: ________________________________________________
Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.
Reference standards and test results shall be fully explained and comparable to specified product data.
Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:
1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including architectural/engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted by:

Signature ____________________________________  For use by HSR Associates, Inc.
Firm: _________________________________________  ____ Accepted  ____ Accepted as noted
Address _________________________________________  ____ Not Accepted  ____ Received too late

By: ___________________________________________
Date: _________________________________________
FAX: _________________________________________

Attachments:

19021 Western Apprenticeship
Center Remodel 01 63 00 - 1
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition.
C. Cutting and patching.
D. Cleaning and protection.
E. Starting of systems and equipment.
F. Demonstration and instruction of Owner personnel.
G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
H. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS
A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
B. Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
C. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.
D. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Cutting and Patching Beyond Work Identified on Plans: Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Alternatives to cutting and patching.
      f. Effect on work of Owner or separate Contractor.
      g. Written permission of affected separate Contractor.
      h. Date and time work will be executed.
C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 REQUIREMENTS OF REGULATORY AGENCIES
A. Comply with National Electric Code for temporary power.
B. Comply with Federal, State and local codes and regulations, and with utility company requirements.

1.05 PROJECT CONDITIONS
A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
B. Protect site from pudding or running water. Provide water barriers as required to protect site from soil erosion.
C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

G. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 CONTRACT LIMITS AND PROTECTION OF EXISTING CONDITIONS

A. All work shall be confined within the Contract limits indicated on the Project Drawings. Do not infringe upon other areas without the permission of the AE. If not indicated otherwise, consider the property lines to be the Contract limits.

B. Existing property, buildings, walks, curbs, trees, shrubs, lawns, boulevards, and the Work of other Contractors, which are damaged or disturbed outside the Contract limits shall be restored to original condition or better. Contractor shall be responsible for the damage or disturbance and shall restore disturbed lawn areas with sod and replace damaged trees and shrubs.

C. Existing shrubs and trees indicated on the Project Drawings to remain shall be protected from physical damage. Observe the following precautions within a distance of 15 feet of the trunk of such trees:
   1. Install temporary fencing as required to control traffic under trees.
   2. Dump no trash, especially concrete, plaster, mortar, or wash water.
   3. No storing of cement, plaster, concrete block, brick and similar products.
   4. Provide and maintain good drainage; no ponding water permitted.
   5. Clean up the area immediately as nearby construction work is completed.

1.07 COORDINATION

A. See Section 01 10 00 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.
PART 3 EXECUTION

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

3.02 PREPARATION
A. Clean substrate surfaces prior to applying next material or substance.
B. Seal cracks or openings of substrate prior to applying next material or substance.
C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK
A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Contractor shall locate and protect survey control and reference points.
D. Control datum for survey is that established by Owner provided survey.
E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
H. Utilize recognized engineering survey practices.
I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.
K. Periodically verify layouts by same means.
L. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS
A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
E. Make neat transitions between different surfaces, maintaining texture and appearance.
3.05 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.
   3. Relocate items indicated on drawings.
   4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. See Section 01 10 00 for other limitations on outages and required notifications.
      c. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

E. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
   1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
   2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
   3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

H. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

I. Clean existing systems and equipment.

J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

K. Do not begin new construction in alterations areas before demolition is complete.

L. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

D. Unless noted otherwise, each major subcontractor shall be responsible for all cutting and patching of the existing structure and appurtenances to complete that subcontractors Work for this Project.

E. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

F. General Contractor is responsible to verify warranty requirements at areas of alteration and to make certain that required certified installers are employed for repairs to maintain said warranty.

G. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

H. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

I. Restore work with new products in accordance with requirements of Contract Documents.

J. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

K. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
   4. At patches/repairs in rated walls verify required UL fire rating design to confirm integrity of fire rating at completion of repair.

3.07 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Accomplish rubbish removal weekly and additionally as directed by the AE. Keep interior of building free of unattended combustible rubbish at all times.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

E. Remove all tools, equipment, scaffolding and temporary facilities immediately when no longer required for execution of the Work.

F. As used herein, the term "premises" shall include all areas within and outside the construction limits which have been soiled, littered or disturbed in any manner by the Work of the Project.

3.08 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Protect installed work from damage by construction operations. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
  1. The General Contractor shall assume responsibility for the floors being in like new condition upon completion of the Project.
  2. Exercise care to prevent damage to exposed, finished concrete floor surfaces during the course of construction of the Project. Remove all spills or smears immediately and sweep floors frequently.
  3. Instruct all workmen and deliverymen to exercise caution against accidental damage to the floors by actions such as dropping heavy objects like tools and products, or scratching by sliding objects, or scoring by vibration from metal legs of stand mounted power tools, or permanent discoloration from oil dripping from pipe thread cutting machine, or the like.
  4. Avoid using areas with exposed concrete floors as workshops or in any other way which would damage the finished floors. When rooms or areas must be so used, cover floor with 5/8 inch thick plywood panels fastened together and underlain with 10 mil minimum plastic taped in place.
  5. Allowable Carpet Protection:
     a. Pedestrian Traffic: Polyethylene protective film, industrial duty, temporary protection, plastic carpet film with a pressure sensitive water-based self adhesive system allowing clean release for easy removal without adhesive transfer. Any other protection system shall be approved by A/E.
     b. Equipment Traffic (wheelbarrows, carts etc.): Plywood or similar board protection over 10 mil minimum reinforced plastic taped in place over floor finish.
  6. Allowable Resilient and Hard Surface Floor Protection:
     a. Plywood sheets over 10 mil minimum reinforced plastic, resin paper or tarp taped in place.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Prohibit traffic from landscaped areas.

H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

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

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer’s representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.
3.10 DEMONSTRATION AND INSTRUCTION
A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.

3.11 ADJUSTING
A. Adjust operating products and equipment to ensure smooth and unhindered operation.
B. Testing, adjusting, and balancing HVAC systems: See Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

3.12 FINAL CLEANING
A. Execute final cleaning after Substantial Completion but before making final application for payment. Clean all surfaces to condition acceptable for immediate occupancy by the Owner.
B. Use cleaning materials that are nonhazardous.
C. Remove all marks, stains, fingerprints, paint droppings and other foreign matter from all finished surfaces.
D. Clean and polish all hardware.
E. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
F. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
G. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
H. Replace filters of operating equipment.
I. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
J. Clean site; sweep paved areas, rake clean landscaped surfaces.
K. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 SUBSTANTIAL COMPLETION
A. Comply with General Conditions of the Contract for Construction and Supplementary Conditions for reaching Substantial Completion.

3.14 FINAL INSPECTION
A. Comply with General Conditions of the Contract for Construction and Supplementary Conditions for completing Final Inspection.
B. Refer to 00 73 00 Supplementary Conditions, Article 9 for time line to complete Final Inspection.

3.15 MAINTENANCE
A. Provide service and maintenance of components indicated in specification sections.
B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than two years from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION
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PART 1  GENERAL

1.01  SECTION INCLUDES
   A. Project Record Documents.
   B. Operation and Maintenance Data.
   C. Warranties and bonds.

1.02  RELATED REQUIREMENTS
   A. Section 00 72 00 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
   B. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
   C. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
   D. Individual Product Sections: Specific requirements for operation and maintenance data.
   E. Individual Product Sections: Warranties required for specific products or Work.

1.03  SUBMITTALS
   A. Prior to requesting Architect/Engineer's final inspection for certification of final acceptance and final payment, as required by General Conditions, complete the following and list known exceptions (if any) in request:
      1. Submit final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
      2. Submit updated final statement, accounting for additional (final) changes to Contract Sum.
      3. Submit certified copy of Architect/Engineer's final punch list of itemized work to be completed or corrected (including equipment requiring final connection), stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect/Engineer.
      4. Submit record documents, as-built drawings, maintenance manuals, damage or settlement survey, property survey, and similar final record information as described in Part 3 below.
      5. Complete final clean up requirements, including touch-up painting of marred surfaces.
      6. Submit final meter readings for utilities, measured record of stored fuel, and similar data as of time of Substantial Completion or when Owner took possession of and responsibility for corresponding elements of the work.
      7. Submit consent of surety.
      8. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.
      9. Submit test, inspection and acceptance certificates as required in each product section of the Specifications.
     10. Submit Contractor's Affidavit and Lien Waivers.
     11. Submit lien waivers from all Subcontractors, sub-subcontractors and major material suppliers who have furnished material or labor for the Work under contract with the Contractor or Subcontractor. The lien waivers shall be in the full amount of the Contract involved.
     12. Operation and Maintenance Data:
         a. As requested by the Owner and prior to final acceptance, organize maintenance-and-operating manual information into two (2) complete sets, each in manageable size, and bind into individual 3-ring binders properly identified with table of contents and tabbed accordingly. Or organized in similar fashion in PDF format. Include emergency instructions, spare parts listing, copies of warranties, wiring diagrams, recommended "turn-around" cycles, inspection procedures, shop drawings, product data, and similar applicable information.
         b. If project includes multiple sites, provide number of sets of manuals for each site as indicated above.
         c. Provide additional manuals as required by product specification sections.
         d. As-built temperature control drawings.
         e. Mechanical testing report from 23 05 93.
13. Warranties and Bonds:
   a. Guarantees and warranties as required in each product section of the Specifications.
   b. For equipment or component parts of equipment put into service during construction with
      Owner's permission, submit documents within 10 days after acceptance.
   c. Make other submittals within 10 days after Date of Substantial Completion, prior to final
      Application for Payment.
   d. For items of Work for which acceptance is delayed beyond Date of Substantial Completion,
      submit within 10 days after acceptance, listing the date of acceptance as the beginning of the
      warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 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. Ensure entries are complete and accurate, enabling future reference by Owner.
   C. Store record documents separate from documents used for construction.
   D. Record information concurrent with construction progress.
   E. 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 utilized.
      3. Changes made by Addenda and modifications.
   F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
      1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced
         to permanent surface improvements.
      2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to
         visible and accessible features of the Work.
      3. Field changes of dimension and detail.
      4. Details not on original Contract drawings.

3.02 WARRANTIES AND BONDS
   A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and
      manufacturers, within 10 days after completion of the applicable item of work. Except for items put into
      use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial
      completion is determined.
   B. Verify that documents are in proper form, contain full information, and are notarized.
   C. Co-execute submittals when required.
   D. Retain warranties and bonds until time specified for submittal.
   E. Include originals of each in operation and maintenance manuals, indexed separately on Table of
      Contents.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS
A. Section 01 10 00 - Summary: Limitations on Contractor’s use of site and premises.
B. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE
A. Refer to drawings for extents of work.
B. Remove other items indicated, for salvage and relocation.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS
A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Use of explosives is not permitted.
   3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   4. Provide, erect, and maintain temporary barriers and security devices.
   5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   7. Do not close or obstruct roadways or sidewalks without permit.
   8. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
B. Do not begin removal until receipt of notification to proceed from Owner.
C. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
D. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.
E. Temporary Shoring
   1. Provide temporary shoring of load bearing structure where new openings are cut in load bearing walls, floors or ceilings. When required, Contractor shall provide services of a structural engineer registered in the state where work is performed for design of shoring. Use means and methods to prevent damage to floors and adjacent finished surfaces. Repair adjacent construction and finishes damaged during removal work.
F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

I. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark interior utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Verify that abandoned services serve only abandoned facilities before removal.
   3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; do not burn or bury.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.
SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
   B. Openings for other work.
   C. Form accessories.
   D. Form stripping.

1.02 RELATED REQUIREMENTS
   A. Section 03 20 00 - Concrete Reinforcing.
   B. Section 03 30 00 - Cast-in-Place Concrete.
   C. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-
in-place concrete.

1.03 REFERENCE STANDARDS
   A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
   B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
   C. ACI 347R - Guide to Formwork for Concrete; 2014.
   D. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on void form materials and installation requirements.
   C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

1.05 QUALITY ASSURANCE
   A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural
      Engineer experienced in design of concrete formwork and licensed in the State in which the Project is
      located.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver prefabricated forms and installation instructions in manufacturer’s packaging.
   B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from
      moisture.

PART 2 PRODUCTS
2.01 FORMWORK - GENERAL
   A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place
      concrete work.
   B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
   C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal
      of formwork.
   D. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.02 WOOD FORM MATERIALS
   A. Softwood Plywood: PS 1, C Grade, Group 2.
   B. Reveals and Chamfers: Wood or purpose-made plastic or high density plastic foam to achieve sharp,
      true lines.

2.03 REMOVABLE PREFABRICATED FORMS
   A. Preformed Steel Forms: Minimum 16 gage, 0.0598 inch thick, matched, tight fitting, stiffened to support
      weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
2.04 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, 1 inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
   1. Composition: Colorless reactive, mineral oil-based, soy-based, or vegetable-oil based compound.
   2. Do not use materials containing diesel oil or petroleum-based compounds.
   3. VOC Content: None; water-based.

C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

D. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 12 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members that are not indicated on drawings.

F. Coordinate this section with other sections of work that require attachment of components to formwork.

G. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.03 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.04 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.
   1. Plumbing, Heating and Electrical Items:
      a. Pre-manufactured items including inserts, sleeves and other embedded items required by mechanical, electrical and plumbing trades shall be supplied, accurately located, and installed by respective trades.
      b. Site fabricated box outs for chases, sleeves and other miscellaneous openings for mechanical, electrical and plumbing trades shall be supplied and installed by Formwork Contractor.
      c. Location of mechanical, electrical and plumbing inserts, embedded parts, openings and recesses shall be coordinated with respective trades.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
3.05 JOINTS AND EDGE FORMING
   A. Locate construction joints per industry standards. Form construction joints with keyway, including joint between footings and foundation wall. Place joints perpendicular to main reinforcement and continue reinforcement through joint.
   B. Set edge forms or bulkheads and intermediate screed strips to obtain the required elevations and contours in the finished slab surface.

3.06 FORM CLEANING
   A. Clean forms as erection proceeds, to remove foreign matter within forms.
   B. Clean formed cavities of debris prior to placing concrete.
      1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
      2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 FIELD QUALITY CONTROL
   A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.08 FORM REMOVAL
   A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
   B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
   C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION
SECTION 03 20 00
CONCRETE REINFORCING

PART 1  GENERAL

1.01 SECTION INCLUDES
A. Reinforcing steel for cast-in-place concrete.
B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS
A. Refer to Structural Drawings for additional design information.
B. Section 03 10 00 - Concrete Forming and Accessories.
C. Section 03 30 00 - Cast-in-Place Concrete.
D. Section 03 41 13 Precast Concrete Hollow Core Planks: Reinforcement for precast planks.
E. Section 04 20 00 - Unit Masonry: Reinforcement for masonry.

1.03 REFERENCE STANDARDS
A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
H. CRSI (P1) - Placing Reinforcing Bars; 2011.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
C. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.05 QUALITY ASSURANCE
A. Perform work of this section in accordance with ACI 301.

1.06 DELIVERY, STORAGE AND PROTECTION
A. Deliver reinforcing steel to Project Site bundled, tagged and marked. Use metal tags indicating bar size, lengths and other information corresponding to markings shown on placement diagrams. Do not remove tags until reinforcing is in place.
B. Store reinforcement materials at Project Site in manner to prevent damage, accumulation of dirt and excessive rust.

PART 2  PRODUCTS

2.01 REINFORCEMENT
A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Deformed billet-steel bars.
   2. Unfinished.
B. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M. Electrically welded 65,000 psi yield strength.
   1. Form: Flat Sheets.
C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. Supports over waterproofing shall be chairs with plates.

D. Slab-On-Grade Poly Fiber Reinforcement Systems:
   1. Synthetic Structural Fiber Reinforcement: Provide synthetic structural fibers complying with the following requirements:
      a. Synthetic structural fibers shall meet requirements of ASTM C 1116, Paragraph 4.1.3, Type III.
      b. Synthetic structural fibers shall be monofilament, made of polypropylene or polypropylene/polyethylene blend.
      c. Synthetic structural fibers shall have a minimum length of 1.38 inches (35 mm) and a maximum length of 2.00 inches (51 mm).
      d. Specific gravity between 0.90 and 0.95.
      e. Synthetic structural fibers shall have an aspect ratio (length divided by equivalent diameter of fiber) between 60 and 100.
      f. Dosage rate:
         1) Slab-On-Grades: 5.0 lbs/cubic yard or the addition rate to achieve the concrete required minimum equivalent flexural strength, $f_{e3}$ of 165 psi for a concrete with a compressive strength of 4,000 psi at 28 days. Determined from the manufacturer's test data verifying fiber performance in concrete based on ASTM C1609-05, utilizing the beam size 6” x 6” x 20” ($f_{e3}$) calculated using JCI-SF4 method.
      g. Synthetic structural fibers shall be:
         1) General Resource Technology, Advantage Macrosynthetic Fiber
         2) Grace STRUX, 90/40 synthetic fiber.
         3) Propex Concrete Systems, Novomesh 950 Synthetic Fiber.
         4) Euclid Chemical Company, Tuf-Strand SF.

2.02 UNACCEPTABLE MATERIALS
   A. Reinforcement with any of the following defects will not be permitted in the work:
      1. Bar lengths, depths and bends exceeding specified fabrication tolerances.
      2. Bends or kinks not indicated on drawings or final shop drawings.
      3. Bars with reduced cross-section due to excessive rusting or other cause.

2.03 FABRICATION
   A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
   B. Welding of reinforcement is permitted only with the specific approval of Architect. Perform welding in accordance with AWS D1.4/D1.4M.
   C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION
3.01 PLACEMENT
   A. Comply with CRSI's "Recommended Practice for Placing Reinforcing Bars".
   B. Clean reinforcement to remove loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
   C. Place, support and secure reinforcement against displacement. Do not deviate from required position.
   D. Do not displace or damage vapor barrier.
   E. Accommodate placement of formed openings. Provide additionally a minimum of two #5 bars all around openings.
   F. Provide two #3 bars, 3 inches apart four sides of floor drains in slabs-on-grade.
   G. Maintain concrete cover around reinforcing as follows:
      1. Column Ties: 1 1/2 inch.
      2. Walls (exposed to weather or backfill): 1 1/2 inch.
      3. Footings and Concrete Formed Against Earth: 3 inch.
H. Tend to reinforcing at all times during concrete placement and make necessary adjustments to reinforcing which has been dislodged by concrete placement or workmen.

I. Comply with applicable code for concrete cover over reinforcement.

J. Bond and ground all reinforcement to requirements of Division 26.

3.02 SPLICES
   A. Provide standard reinforcement splices as detailed by lapping ends, placing bars in contact, and tightly wire tying.
   B. Comply with requirements of ACI 318 for minimum lap dimensions.

3.03 WELDED WIRE FABRIC
   A. Install welded wire fabric in longest practicable lengths and cut to fit all penetrations.
   B. Lap adjoining pieces at least one full mesh but not less than 6 inches. Tie splices with 16 gauge wire or standard metal clip. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.
   C. Place mesh flat, without roll or curling.
   D. When detailed to include welded wire fabric in slabs on grade and structural topping concrete, place mesh at mid-point of slab and topping thickness.

3.04 FIELD QUALITY CONTROL
   A. Bar Placement Tolerance
      1. 1/4 inch (plus or minus) between bars.
      2. 3/8 inch (plus or minus) for members 4-12 inches deep.
      3. 1/2 inch (plus or minus) for members over 12 inches deep
   B. Notify Architect/Engineer when reinforcing is in place so a review of reinforcement placement can be made prior to placement of concrete.

END OF SECTION
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Floors and slabs on grade.
B. Concrete walls and footings.
C. Joint devices associated with concrete work.
D. Underslab vapor barrier.
E. Concrete curing.

1.02 RELATED REQUIREMENTS
A. Refer to Structural Drawings for additional design information.
B. Section 01 40 00 - Quality Requirements
C. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
D. Section 03 20 00 - Concrete Reinforcing.
E. Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
F. Division 9 Floor Finishes: Restrictions for compatibility of flooring adhesives in regards to curing compounds, sealers and slab moisture content.
G. Section 09 05 61 Common Work Results for Flooring Preparation: Additional floor flatness testing at large format tile locations.

1.03 REFERENCE STANDARDS
C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
F. ACI 305R - Hot Weather Concreting; 2010.
G. ACI 306R - Cold Weather Concrete; 2010.
H. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
T. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
AA. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
AB. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).
AC. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2014.
AD. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric); 2014.
AE. 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; 2011.
AF. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers’ data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
C. Control Joint Drawings: Prior to start of concrete work submit drawings showing proposed construction and control joints for slabs.
D. Samples: Submit samples of underslab vapor retarder to be used.
E. Test Reports: Submit report for each test or series of tests specified.
F. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
G. Laboratory design of concrete mixes and laboratory test reports for concrete materials to Architect/Engineer for approval prior to proceeding with any concrete work Including but not limited to the following:
   1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
   2. Admixtures required to meet job and environment requirements.
H. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
I. Concrete placement schedule. Submit to Architect/Engineer for review prior to placing any concrete.
J. Copies of delivery tickets to Architect/Engineer for each load of concrete delivered to Project. Include items of information as specified herein.
1.05 QUALITY ASSURANCE
   A. Perform work of this section in accordance with ACI 301 and ACI 318.
   B. Follow recommendations of ACI 305R when concreting during hot weather.
   C. Follow recommendations of ACI 306R when concreting during cold weather.
   D. Contractor shall confirm and coordinate various requirements, restrictions or special conditions (i.e. slump, surface finish, curing and sealing compatibility) with floor finish suppliers prior to placing concrete.

PART 2 PRODUCTS

2.01 FORMWORK
   A. Comply with requirements of Section 03 10 00.

2.02 REINFORCEMENT MATERIALS
   A. Comply with requirements of Section 03 20 00.

2.03 CONCRETE MATERIALS
   A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
      1. Acquire cement for entire project from same source.
   B. Air Entraining Portland Cement: ASTM C 150, Type 1A.
   C. Fine and Coarse Aggregates: ASTM C33/C33M.
      1. Acquire aggregates for entire project from same source.
   D. Fly Ash: ASTM C618, Class C.
   E. Calcined Pozzolan: ASTM C 618, Class C.
   F. Slag Cement:
      1. Slag Cement shall meet requirements of ASTM C989. The Silica fume admixture shall be EMSAC F-100.
   G. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
      1. EMSAC F-100 by Elkem Chemicals, Inc.
      2. Force 10,000 by W.R. Grace.
      3. Lafarge SF Cement by Lafarge Corporation.
      4. MasterLife SF100 by BASF Corporation.
   H. Water: Clean and not detrimental to concrete in accordance with ASTM C1602.

2.04 ADMIXTURES
   A. Except for air entraining and water reducing, admixtures are not permitted without approval of Architect/Engineer. Submit manufacturer's information to A/E with historical stress testing.
   B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
   C. Air Entrainment Admixture: ASTM C 260. Use for exterior walls, exterior slabs, walks, platforms, ramps, steps, portions of parking ramp and other concrete exposed to freezing and thawing. Air entrainment not allowed at interior floor slabs.
      1. Products:
         b. AEA 92S - Euclid.
         c. Catexol AE 260 - Axim Concrete Technologies
         d. General Resource Technology - Polychem SA-50
         e. MasterAir Series – BASF Corporation
         f. Substitutions: See Section 01 60 00 - Product Requirements.
   D. Mid-Range Water Reducing: ASTM C494/C494M Type A or Type F.
      1. Products: Subject to compliance with requirements, provide one of the following:
         b. Eucon MR - Euclid.
         c. Catexol 3500N" – Axim Concrete Technologies
d. General Resource Technology - KB-1200
e. MasterPolyheed Series" - BASF Corporation
f. Substitutions: See Section 01 60 00 - Product Requirements.

E. High Range Water Reducing Admixture (Super Plasticizer: ASTM C494/C494M Type F or type G.
1. Products: Subject to compliance with requirements, provide one of the following:
   b. ADVA 100 - W.R. Grace & Co.
   c. Catecol 1000SP-MN – Axim Concrete Technologies
   d. General Resource Technology - Melchem Superplasticizer
e. MasterRheobuild 1000 or MasterGlenium Series - BASF Corporation
f. Substitutions: See Section 01 60 00 - Product Requirements.

F. Water Reducing, Non-Chloride Accelerating Admixture: ASTM C494/C494M Type C or E.
1. Products: Subject to compliance with requirements, provide one of the following:
   b. Catecol 2000RHE – Axim Concrete Technologies
c. General Resource Technology - Polychem Superset
d. MasterSet AC 534 or MasterSet FP 20 - BASF Corporation
e. Substitutions: See Section 01 60 00 - Product Requirements.

G. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
1. Products: Subject to compliance with requirements, provide one of the following:
   b. Eucon Retarder 100 - Euclid.
c. Catecol 1000R – Axim Concrete Technologies
d. MasterSet R Series or MasterSet DELVO Series - BASF Corporation
e. Substitutions: See Section 01 60 00 - Product Requirements.

H. Water Reducing Admixture: ASTM C494/C494M Type A.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. WRDA 82 - W.R. Grace.
   b. MasterPozzolith Series – BASF Corporation
c. Catecol 1000N – Axim Concrete Technologies
d. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent with permeance rating less than .01 perms, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
1. Installation: Comply with ASTM E1643.
2. Accessory Products: Vapor retarder manufacturer’s recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
3. Manufacturers:
   b. Inteplast Group; Barrier-Bac VB-350: www.barrierbac.com/#sle.
c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com/#sle.
g. Vaporblock VB15 by Raven Industries: www.vaporblock.com
h. Substitutions: See Section 01 60 00 - Product Requirements.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
1. Grout: Comply with ASTM C1107/C1107M.
2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
4. Flowable Products:
   b. The QUIKRETE Companies; QUIKRETE® Exterior Use Anchoring Cement:
      www.quikrete.com/#sle.
   c. Substitutions: See Section 01 60 00 - Product Requirements.

5. Low-Slump, Dry Pack Products:
   b. The QUIKRETE Companies; QUIKRETE® FastSet™ Non-Shrink Grout:
      www.quikrete.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf.

D. Moisture-Retaining Cover: ASTM C 171; clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.

E. Bond Breaker: 4 mil plastic, 15# building paper, or vapor retarder returned up on wall.

F. Commercial Tent Tie-downs:
   1. Recessed tie down anchors. Stainless steel with cover.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
   1. Manufacturers:
      d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Epoxy Bonding System:
   1. Manufacturers:
      a. Adhesives Technology Corporation; Crackbond SLV-302, Crackbond LR-321, Crackbond LR-321 LPL, Ultrabond 2100 LPL, Ultrabond 2100, Ultrabond 1, Ultrabond 2, or Ultrabond HS200:  www.atcepoxy.com/#sle.
      b. Adhesives Technology Corporation; Crackbond LR-321 G, or Miracle Bond 1450:  www.atcepoxy.com/#sle.
      c. Dayton Superior Corporation; Slow Set Bonding Agent:  www.daytonsuperior.com/#sle.
      d. Kaufman Products Inc; SurePoxy HM EPL:  www.kaufmanproducts.net/#sle.
      e. Kaufman Products Inc; SurePoxy HM Class B:  www.kaufmanproducts.net/#sle.
      h. Substitutions: See Section 01 60 00 - Product Requirements.

C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
   2. Manufacturers:
      c. Sakrete: Concrete Expansion Joint.  www.sakrete.com
      d. Quikrete: Concrete Expansion Joint.  www.quikrete.com
      f. Substitutions: See Section 01 60 00 - Product Requirements.
D. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
   1. Manufacturers:
      c. Substitutions: See Section 01 60 00 - Product Requirements.

E. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel or plastic, with minimum 1 inch diameter holes for conduit or rebars to pass through at 6 inches on center; ribbed steel stakes for setting. Removable screed cap to form minimum 1/4 inch wide by 3/8 inch deep joint.
   1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
   2. Height: To suit slab thickness.
   3. Manufacturers:
      c. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 CURING MATERIALS
A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
   1. Manufacturers:
      b. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com/#sle.
      d. BASF Admixtures, Inc.; Confilm.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Curing Compound, Non-dissipating: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C309.
   2. Gloss: Low.
   4. VOC Content: OTC compliant.
   5. Manufacturers:
      d. The QUIKRETE Companies; QUIKRETE® Acrylic Concrete Cure & Seal: www.quikrete.com/#sle.
      e. SpecChem, LLC; Cure and Seal WB: www.specchemllc.com/#sle.
      f. Substitutions: See Section 01 60 00 - Product Requirements.

C. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.
   3. VOC Content: OTC compliant.
   4. Manufacturers:
      b. Kaufman Products Inc; Krystal 30 OTC, or Krystal 30 Emulsion: www.kaufmanproducts.net/#sle.
      c. SpecChem; Cure & Seal 25. www.specchemllc.com
      d. Lucas Products: #7200 Cure Seal Water Based. www.rmlucas.com
i. TK Products; TK-Kure & Seal VOC. www.tkproducts.com
j. Substitutions: See Section 01 60 00 - Product Requirements.

D. Moisture-Retaining Sheet: ASTM C171.
   1. Curing paper, regular.
   2. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
   3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

E. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag,
      silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or
   required by manufacturer.

C. Normal Weight Concrete: Design all concrete mixes from the following table of requirements:

<table>
<thead>
<tr>
<th>W/C %</th>
<th>% AIR</th>
<th>MAX SLUMP</th>
<th>f'c (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MAX +1%</td>
<td>(inches)</td>
</tr>
<tr>
<td>1. Concrete backfilled or protected</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from weather:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Footings:</td>
<td>0.55</td>
<td>4</td>
<td>Refer to Struct Dwgs</td>
</tr>
<tr>
<td>b. Foundation walls:</td>
<td>0.50</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>c. Slabs - Interior on Grade:</td>
<td>0.50</td>
<td>3</td>
<td>Refer to Struct Dwgs</td>
</tr>
</tbody>
</table>

1. Fly Ash Content: Maximum 20 percent of cementitious materials by weight when used alone.
   a. At walls, piers, interior slab on grade, bond beams and metal pan stairs: A maximum of 50
      percent total replacement of portland cement with GGBFS (Ground Granulated Blast-Furnace
      Slag) and fly ash at a 1:1 ratio; up to 350 pounds, with a maximum 20 percent fly ash.
   b. At exposed columns, exterior slab on grade and miscellaneous non-scheduled concrete: A
      maximum of 20 percent total replacement of Portland cement with GGBFS (Ground
      Granulated Blast-Furnace Slag) and fly ash at a 1:1 ratio where freeze-thaw durability and
      exposure to deicers is likely; up to 350 pounds, with a maximum 20 percent fly ash.

2. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
   a. Note: Total of combination of flyash and calcined pozzolone shall not exceed 20 percent.

3. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.

4. Minimum Cement Content:
   a. f'c=3 ksi: 5 sacks
   b. f'c=3.5 ksi & 4 ksi: 5 1/2 sacks

5. Maximum Coarse Aggregate Size: For footings 1 1/2 inch.

2.09 MIXING
   A. Transit Mixers: Comply with ASTM C94/C94M except where requirements in table above are more restrictive.
   B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION
   A. Inspect all excavations and/or prepared subgrade for suitability of pouring concrete. No standing water, organic material, debris, etc., should be present. Slab subgrade should be compacted as specified and have optimum moisture content.
   B. Points of concrete placement shall be clean, damp but not wet surfaces, or properly consolidated fills, but never soft mud, dry porous earth, or frozen ground.
   C. Verify that forms are clean and free of rust before applying release agent.
   D. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
   E. Contractor shall make certain that references to all related sections for floor finishes and their substrate finish requirements are complied with including but not limited to; mix/slump, flatness, curing/sealing compounds, curing timeframe, aggregate colors etc.
   F. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in accordance with bonding agent manufacturer's instructions.
      1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
      2. Use latex bonding agent only for non-load-bearing applications.
   G. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Sheet shall lap up at all wall surfaces and be secured by tape or with control joint material where it is indicated to be installed. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering. Vapor retarder may perform as the required bond break at slab edge.
      1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.
   H. Repair underslab vapor barrier damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

3.03 PLACING CONCRETE
   A. Place concrete in accordance with ACI 304R.
   B. Place concrete for floor slabs in accordance with ACI 302.1R.
   C. Ensure reinforcement, inserts, and embedded parts will not be disturbed during concrete placement.
   D. Addition of water or admixtures to concrete on site without written approval of Architect/Engineer is prohibited and shall be grounds for rejection.
   E. Convey concrete from mixing to point of placement rapidly and continuously until unit of operation is completed using methods which prevent segregation or loss of ingredients. Deposit at or very near final placement position. Use chutes such that the concrete slides in the chute and does not flow. For vertical drops more than 5 feet, utilize tremies or similar devices to prevent segregation of concrete ingredients. Do not convey or handle concrete in containers or devices made of aluminum.
   F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
G. Consolidate placed concrete by vibration so the concrete is thoroughly worked around reinforcement, around embedded items, and into corners of forms, eliminating air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Use mechanical vibrators with a minimum frequency of 7,000 revolutions per minute, operated by competent workmen. Use of vibrators to move concrete within forms is not permitted. Insert and withdraw vibrators at many points, from 18 to 30 inches apart for 5 to 10 seconds duration. Keep a spare vibrator on the Project Site during all concrete placement operations. Use vibrators of internal type, apply directly to concrete, not through formwork, except in sections too thin to permit insertion of internal type, in which case, employ use of form vibrators approved by Architect/Engineer.

H. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

I. Concrete in vertical members shall have been in place at least four hours before concrete in horizontal or vertical members resting thereon is placed.

J. Placing concrete shall be continuous between vertical construction joints. Make vertical construction joints at approximately the center of a panel or beam, in a straight line to the full depth. See Project Drawings for location of architecturally delineated construction joints.

3.04 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
   2. Conform to Section 07 92 00 for finish joint sealer requirements.

D. Saw Cut Contraction Joints: Saw cut joints as soon as joints can be cut without joint deformation; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab. Apply specified sealant from 07 92 00 flush with floor.

E. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

F. Separate slabs on grade from vertical surfaces with bond break of #15 felt, 6 mil poly or slab vapor barrier.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 40 00, will inspect finished slabs for compliance with specified tolerances.

B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
   1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
   2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
   3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
   4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.

C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 COLD WEATHER REQUIREMENTS

A. Cold weather requirements govern when minimum ambient temperature is expected to fall below 40 degrees F.
   1. Concrete will not be placed on frozen ground.
   2. Mix, place, protect and cure concrete in strict accordance with ACI 306 R-88 "cold Weather Concreting".
3.07 HOT WEATHER REQUIREMENTS
A. Hot weather requirements govern when maximum ambient temperature is expected to rise above 85 degrees F.
B. Mix, place, protect and cure concrete in strict accordance with ACI 305R.
C. Admixtures proposed for construction under these conditions, such as water-reducing retarders, shall be tested thoroughly with concrete mixes for this job. All aspects of concrete construction applicable shall be considered before approval. Submit specifications on retarder to Engineer for approval with concrete mix designs.
D. Batch, mix and transport concrete per ACI 304R.
E. Water curing will be required for hot weather construction.

3.08 CONCRETE FINISHING
A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R thin floor coverings include carpeting and resilient flooring. High gloss finish from power trowel not acceptable.
   2. Surfaces to be Sealed: Troweled finish.
B. Exterior Foundation Wall Surface Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height. Fill tie break-off holes with grout flush with wall.

3.09 CURING AND PROTECTION
A. Take every precaution to insure that all concrete operations are performed promptly and without interruption.
B. Moisture cure slabs only. Exception; where curing/sealing compounds are indicated.
C. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
D. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
   2. High early strength concrete: Not less than four days.
E. Begin final curing after initial curing but before surface is dry.
F. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
G. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water-fog spray or saturated burlap.
   3. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Cover: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      b. Curing/Sealing Compound (At sealed concrete locations only): Apply in two coats at right angles, using application rate recommended by manufacturer.

3.10 FIELD QUALITY CONTROL
A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
B. Provide free access to concrete operations at project site and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
D. Record time, place, mix design, quantity, slump, concrete temperature, air temperature and weather conditions, cylinders taken, date shoring is removed, curing and other data pertaining to concrete placement.
E. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

F. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure four concrete test cylinders. Obtain test samples for first 50 cu yd or less of each class of concrete placed. Cast one set of four test cylinders for each additional 100 cu. yd.
   1. Test one (1) cylinder at 7 days and two (2) cylinders at 28 days and (1) on hold.
   2. For first set of cylinders cast for slab-on-grade, test one (1) cylinder at 3 days. Analyze probable 28 day strength. Inform Architect/Engineer immediately by telephone if there appears to be concern for achieving required 28 day strength.
   3. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
   4. If reasonable consistency of slump and air tests is recorded on 4 consecutive tests, testing company may reduce requirements to test every 150 cu. yd.

G. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

H. Deviation from specifications shall be grounds for rejection.

I. Addition of water or admixtures to concrete on site without written approval of Architect/Engineer is prohibited and shall be grounds for rejection.

3.11 MOISTURE TESTING

A. Testing requirements are addressed in Section 09 05 61.

3.12 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

END OF SECTION
SECTION 03 41 13
PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Precast floor planks.
B. Connection plates with brackets and hangers.
C. Grouting plank joint keys.

1.02 RELATED REQUIREMENTS
A. Section 03 30 00 - Cast-in-Place Concrete: Concrete topping
B. Section 04 05 11 - Mortar and Masonry Grout: Grout for plank joints.

1.03 REFERENCE STANDARDS
A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
O. PCI (CERT) - PCI Plant Certification; Precast/Prestressed Concrete Institute; online at www.pci.org.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.
C. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
   B. Erector Qualifications: Company specializing in performing the type of work specified in this section, with minimum 3 years of documented experience.
   C. Welder Qualifications: Qualified within previous 12 months in accordance with AWS B2.1/B2.1M.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Precast Concrete Hollow Core Planks: 
      1. Any manufacturer with PCI Plant Certification.
      2. Any manufacturer with NPCA Plant Certification.

2.02 PRECAST UNITS
   A. Precast Hollow Core Planks: Comply with PCI MNL-120, PCI MNL-126, PCI MNL-124, ACI 318, and ACI 301.
      1. Dimensions as indicated on drawings.
      2. Design components to withstand dead loads and design loads in the configuration indicated on drawings and as follows:
      3. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with strength requirements.
      4. Design connections in accordance with PCI MNL-123.
      5. Design components to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.
      6. Grouted Keys: Capable of transmitting horizontal shear force of 2,000 pounds per linear foot.

2.03 MATERIALS
   A. Concrete Materials: ACI 301.
   B. Tensioning Steel Tendons: ASTM A416/A416M, Grade 250 - 250K psi; seven-wire stranded steel cable; low-relaxation type; full length without splices; weldless; uncoated.
   C. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) deformed steel bars.
   D. Non-Shrink Grout: Non-metallic, minimum compressive strength of 10,000 psi at 28 days.
   E. Cement Grout: Minimum compressive strength of 3,000 psi at 28 days.

2.04 ACCESSORIES
   A. Connecting and Supporting Devices: Plates, angles, items cast into concrete, items connected to steel framing members, and inserts: ASTM A36/A36M carbon steel; prime painted.
   B. Core Hole End Plugs: Cardboard insert with stiff concrete fill.
   C. Bearing Pads: High density plastic, 1/8 inch thick, smooth on one side. Vulcanized elastomeric compound molded to size.
   D. Sill Seal: Compressible glass fiber strips.

2.05 FABRICATION
   A. Weld reinforcing in accordance with AWS D1.4/D1.4M.
   B. Embed anchors, inserts, plates, angles, and other items at locations indicated.
   C. Provide openings required by other sections, at locations indicated.
D. Cut exposed ends flush.
E. Plant Finish: Finish members to PCI MNL-116 Standard Grade.
F. Connecting and Supporting Steel Devices: Do not paint surfaces in contact with concrete or surfaces requiring field welding.

2.06 FABRICATION TOLERANCES
A. Comply with PCI MNL-116 and PCI MNL-135.

2.07 SOURCE QUALITY CONTROL
A. Produce planks in accordance with requirements of PCI MNL-116. Maintain plant records and quality control program during production of precast planks. Make records available upon request.
B. Inspect and test stressing tendons before delivery for compliance with specified standards.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that site conditions are ready to receive work and field measurements are as indicated on shop drawings.

3.02 PREPARATION
A. Prepare support devices for the erection procedure and temporary bracing.

3.03 ERECTION
A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
B. Install bearing pads and sill seal at bearing ends of planks as indicated.
C. Align and maintain uniform horizontal and end joints, as erection progresses.
D. Maintain temporary bracing in place until final connection is made. Protect members from staining.
E. Adjust differential camber between precast members to tolerance before final attachment and grouting.
F. Adjust differential elevation between precast members to tolerance before final attachment.
G. Secure units in place. Perform welding in accordance with AWS D1.1/D1.1M.
H. Grout longitudinal keys as indicated.
I. Install sealant backer rod in plank joints to prevent grout leakage.
J. Make plank-to-plank joints smooth using grout, troweled smooth. Transition differential elevation of adjoining planks with grout to a maximum slope of 1:12.

3.04 TOLERANCES
A. Erect members level and plumb within allowable tolerances. Comply with PCI MNL-135.

3.05 CLEANING
A. Clean weld marks, dirt, and blemishes from surface of exposed members.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Mortar for masonry.
   B. Grout for masonry.

1.02 RELATED REQUIREMENTS
   A. Section 04 20 00 - Unit Masonry: Installation of mortar and grout.
   B. Section 08 11 13 - Hollow Metal Doors and Frames: Products and execution for grouting steel door frames installed in masonry.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
   C. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
   D. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
   E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE
   A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of Contract Documents.

1.06 PRECONSTRUCTION TESTING
   A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 40 00 - Quality Requirements.
B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
   1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.

C. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.
   1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.08 FIELD CONDITIONS
A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS
2.01 MORTAR AND GROUT APPLICATIONS
A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
   1. Spec Mix, Inc. (licensed manufacturers only) using the same materials and proportions of material specified above.
   2. Licensed Manufacturers:
      a. Minnesota: Twin City Concrete Products 651-489-8095
      b. Wisconsin: Twin City Concrete Products 800-642-3887, Quickrete Wisconsin 800-657-0789,
   3. Material shall be delivered to jobsite in manufacturer's prepackaged bags indicating manufacturer's name, materials and proportions of materials.
   4. Use manufacturer's proprietary dispensing silo.

B. CMU Mortar Color: Natural gray unless otherwise indicated.

   1. Masonry below grade and in contact with earth: Type S.
   2. Engineered Masonry: Type S.
   3. Exterior, Loadbearing Masonry: Type S.
   5. Interior, Loadbearing Masonry: Type S.
   6. Interior, Non-loadbearing Masonry: Type O.

D. Grout Mix Designs:
   1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
      a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
      b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
   2. Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
      a. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
      b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.02 MATERIALS
A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.

B. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
   1. Type: Fine.
C. Hydrated Lime: ASTM C207, Type N.
D. Quicklime: ASTM C5, non-hydraulic type.
E. Mortar Aggregate: ASTM C144.
F. Grout Aggregate: ASTM C404.
G. Masonry Sand: Shall be clean, sharp, free from loam, silt, vegetable matter, salts, and other injurious substances, and shall conform to ASTM C144. Sand is further subject to approval of the A/E, based on mortar color desired and obtainable by use of local sands readily available, and shall be from one source.
H. Pigments for Colored Mortar for Brick: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): 22H by SGS Solomon Colors. www.solomoncolors.com/#sle
I. Water: Clean and potable.
J. Plasticizer: Not permitted.
K. Water Repellent: Not permitted.
L. Bonding Agent: Latex type.
M. Other Admixtures: Shall not be used at any time. Use of special air-entraining admixtures, chlorides or nitrates, with or without approval, will be sufficient cause to require removal and replacement of all masonry work containing or treated with same.
N. Not Allowed: Anti-freeze compounds and masons cement.

2.03 MORTAR MIXING
A. Conventional Job Mixed Mortar in accordance with ASTM C 270: Measure materials for mortars by volume, in a manner whereby proportions can be controlled within two percent. Mix materials dry and then water to bring to proper consistency for use. Mix materials in the approved type machine mixer of adequate capacity for 3 to 5 minutes after all materials have been introduced, until materials are evenly distributed throughout the batch and the mixture is uniform in color with a workable consistency.
B. Silo Metered and Bulk Container Mortar: Shall comply with ASTM C1714. Use materials specified hereinbefore and proportion mixes as specified hereinafter. Add water and mix according to system manufacturer’s recommendations.
C. Maintain sand uniformly damp immediately before the mixing process.
D. Colored Mortar: Proportion selected pigments and other ingredients to match Architect’s sample, without exceeding manufacturer’s recommended pigment-to-cement ratio; mix in accordance with manufacturer’s instructions, uniform in coloration.
E. Add admixtures in accordance with manufacturer’s instructions; mix uniformly.
F. Do not use anti-freeze compounds to lower the freezing point of mortar.
G. If water is lost by evaporation, re-temper only within two hours of mixing.
H. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.

2.04 GROUT MIXING
A. Mix grout in accordance with ASTM C94/C94M.
B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
C. Add admixtures in accordance with manufacturer’s instructions; mix uniformly.
D. Use maximum water consistent with good workability and freedom from smearing the face of masonry work. Use no mortar that has stood more than one hour after initial mixing. Mortar less than one hour old shall be reasonably re-tempered as necessary to maintain its workability, but used before it is one hour old or otherwise discarded.
E. Use mortar within two hours after mixing up to temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.
F. Do not use anti-freeze compounds to lower the freezing point of grout.
PART 3 EXECUTION

3.01 PREPARATION
A. Apply bonding agent to existing concrete surfaces.
B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION
A. Install mortar and grout to requirements of section(s) in which masonry is specified.
B. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

3.03 GROUTING
A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.
B. Low-Lift Grouting:
1. Limit height of pours to 12 inches.
2. Limit height of masonry to 16 inches above each pour.
3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
C. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
2. Brick: Limit pours to maximum 12 feet in height and 25 feet horizontally.
3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
4. Place grout for spanning elements in single, continuous pour.

3.04 FIELD QUALITY CONTROL
A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 40 00 - Quality Requirements.
B. Test and evaluate mortar in accordance with ASTM C780 procedures.
1. Test frequency: One set of samples prior to start of masonry work.
C. Test and evaluate grout in accordance with ASTM C1019 procedures.
1. Test frequency: One set of samples prior to start of masonry work.
D. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results as specified in individual masonry sections.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Concrete block.
   B. Clay facing brick.
   C. Reinforcement and anchorage.
   D. Flashings.
   E. Accessories.

1.02 RELATED REQUIREMENTS
   A. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
   B. Section 03 30 00 - Cast-in-Place Concrete: Backup substrate for masonry veneer.
   C. Section 04 05 11 - Mortar and Masonry Grout.
   D. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
   E. Section 07 21 19 - Foamed-in-Place Insulation: Expanding foam insulation in wall cavity.
   F. Section 07 42 16 - Metal Wall Panel/Rain Screen Assembly: Air barrier and mineral fiber insulation installed at all exterior locations.
   G. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.
   H. Section 08 11 13 Hollow Metal frames and Doors: Door frames installed in masonry openings to receive bituminous paint at inside surfaces.

1.03 REFERENCE STANDARDS
   C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
   J. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2016.
   O. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
C. Control Joint Drawings: Masonry Contractor and Project Coordinator shall review architectural and structural drawings showing proposed masonry control joints and brick expansion joints. Recommendations for any changes shall be submitted to A/E for review prior to start of Work.
D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

1.05 QUALITY ASSURANCE
A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of Contract Documents.

1.06 MOCK-UP
A. Construct a masonry wall as a mock-up panel sized 3 feet long by 4 feet high; include mortar and accessories and control joint sealant.
B. If necessary, sample sealant bead or beads shall be installed in building movement joints and allowed to assimilate before final color selection.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS
A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, jambs, sash, bonding, and other detailed conditions.
   3. Load-Bearing Units: ASTM C90, normal weight.
      a. Hollow block, as indicated.
      a. Both hollow and solid block, as indicated.
      b. Normal weight.

2.02 BRICK UNITS
A. Manufacturers:
B. Facing Brick: ASTM C216, Type FBX, Grade SW.
   1. Nominal size: As indicated on drawings.
   2. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
   4. Initial Rate of Absorption (IRA): Less than 30g/min/30 sq. in. per ASTM C216-17. Units exceeding this minimum shall be thoroughly wetted. Time frame for wetting shall be determined based on IRA.
2.03 MORTAR AND GROUT MATERIALS
   A. Mortar and Grout: As specified in Section 04 05 11.

2.04 REINFORCEMENT AND ANCHORAGE
   A. Manufacturers:
      3. Substitutions: See Section 01 60 00 - Product Requirements.
   B. Reinforcing Steel: Type specified in Section 03 20 00; size as indicated on drawings; uncoated finish.
   C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
      1. Type: Truss or ladder.
      3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
   D. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
      1. Type: Truss or ladder, with adjustable ties or tabs spaced at 16 in on center.
      3. Size: 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire, width of components as required to provide not less than 5/8 inch of mortar coverage from each masonry face.
      4. Vertical adjustment: Not more than 2 inches.
      5. Insulation Clips: Provide clips at tabs or ties designed to secure insulation against outer face of inner wythe of masonry.
   E. Masonry Veneer Anchors (Steel Stud Back-up): 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
      2. Heckman Building Products; The Wing Nut Pos-i-tie.
      3. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
      4. Wire ties: Manufacturer's standard shape, 0.1875 inch thick by length to within 1 inch of exterior face of brick.
      5. Vertical adjustment: Not less than 3-1/2 inches.
   F. Dovetail Anchors
      1. Heckman; 103
      2. Hohmann Barnard; 315BT
      3. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 FLASHINGS
   A. Metal Flashing Materials:
      1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch thick; finish 2B to 2D.
   B. Self Adhering Membrane Flashing: ASTM D4637/D4637M, Type II, 0.040 inch thick.
      1. Manufacturers:
         a. 3M: Air & Vapor Through Wall Flashing Tape
         e. Polyguard Products, Inc: Polyguard 400 NP/NPW. www.polyguardproducts.com
         f. Substitutions: See Section 01 60 00 - Product Requirements.
   C. Flashing Sealant/Adhesive: Butyl type as specified in Section 07 92 00.
   D. Termination Bars: Stainless steel; compatible with membrane and adhesives.
2.06 ACCESSORIES

A. Preformed Control Joints (compressible filler): Neoprene or rubber material. Provide with corner and tee accessories, fused joints.
   1. Manufacturers:
      c. WIRE-BOND: www.wirebond.com/#sle.
      d. BoMetals, Inc.: www.bometals.com
   e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Joint Filler: Closed cell polyurethane; oversized 50 percent to joint width; self-expanding.

C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
      a. Manufacturers:
         1) Advanced Building Products, Inc; Mortar Break DT: www.advancedbuildingproducts.com/#sle.
         3) Keene Building Products: Keene Mortar Deflector
         4) Substitutions: See Section 01 60 00 - Product Requirements.


E. Weeps/Cavity Vents: Polyester mesh.

F. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating, applied to inside of grouted frames.

G. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.
B. Verify that related items provided under other sections are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
C. Coordinate with steel erection the application of bituminous coating to columns exposed to masonry cavities or surrounded with masonry.
   1. At columns exposed in cavity walls or surrounded with masonry and having a cavity in the masonry, coat column with bituminous coating a minimum 24 inches above grade.
D. Coat inside of hollow metal frames to be grouted with bituminous paint.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
   1. Bond: Running, unless noted otherwise.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
D. Brick Units:
   1. Bond: Running.

3.05 PLACING AND BONDING
A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints.
C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar and mortar smears as work progresses.
E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
F. Interlock intersections and external corners, except for units laid in stack bond.
G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler or firestopping system as required.

3.06 WEEPS/CAVITY VENTS
A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.07 CAVITY MORTAR CONTROL
A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY
A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.
E. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.
F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER
A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
3.10 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTE UNIT MASONRY
A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on drawings.

3.11 MASONRY FLASHINGS
A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.
B. Terminate flashing up 8 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
   2. Anchor vertical leg of flashing into backing with a termination bar and sealant.
   3. Apply cap bead of sealant on top edge of self-adhered flashing.
C. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge.
   1. Base of wall thru-wall flashing shall have a hemmed edge set flush with face of wall.
D. Support flexible flashings across gaps and openings with sloped mortar bed or other permanent means.
E. Extend EPDM and self adhering flashings to within 3/4 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
F. Contractors Option: One piece prefinished metal through-wall flashing in lieu of 2 part fabric flashing / 3 inch prefinished flashing.
G. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.12 LINTELS
A. Install loose steel lintels as noted on plans over non-bearing wall openings, unless noted otherwise.
B. At steel lintels install bond break under bearing portion of lintel.
C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

3.13 CONTROL AND EXPANSION JOINTS
A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
C. Size control joints as indicated on drawings; if not indicated, 1/2 inch wide and deep.
D. Form expansion joint as detailed on drawings.
E. At brick expansion joints located off jambs of openings, install a horizontal expansion joint off top corner of opening the length of fixed lintel bearing distance. Install bond break beneath lintel plate.

3.14 BUILT-IN WORK
A. As work progresses, install built-in metal door frames, glazed frames, and window frames and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
   1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
D. Do not build into masonry construction organic materials that are subject to deterioration.

3.15 CUTTING AND FITTING
A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.
3.16 CLEANING
   A. Remove excess mortar and mortar droppings.
   B. Replace defective mortar. Match adjacent work.
   C. Clean soiled surfaces with cleaning solution as recommended by brick supplier. If no recommendation contact A/E for direction.
   D. Use non-metallic tools in cleaning operations.

3.17 PROTECTION
   A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION
SECTION 04 72 00
CAST STONE MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Architectural cast stone, dry cast.
B. Units required are:
   1. Exterior wall units, including sills.

1.02 RELATED REQUIREMENTS
A. Section 04 05 11 - Mortar and Masonry Grout: Mortar for setting cast stone.
B. Section 04 20 00 - Unit Masonry: Installation of cast stone in conjunction with masonry.
C. Section 07 92 00 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS
A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
E. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009 (Reapproved 2015).
K. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
P. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

1.04 DEFINITIONS
A. Cast Stone - a refined architectural concrete building unit manufactured to simulate natural cut stone, used in unit masonry applications.
   1. Dry Cast Concrete Products – manufactured from zero slump concrete.
      a. Vibrant Dry Tamp (VDT) casting method: Vibratory ramming of earth moist, zero-slump concrete against a rigid mold until it is densely compacted.
      b. Machine casting method: manufactured from earth moist, zero-slump concrete compacted by machinery using vibration and pressure against a mold until it becomes densely consolidated

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Test results of cast stone components made previously by the manufacturer.
C. Shop Drawings: Include key plans, elevations, floor plans when appropriate, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
D. Test results: Submit manufacturers test results of Cast Stone previously made by the manufacturer in the last 90 days, for the following.
   1. Compressive Strength
   2. Absorption
   3. Air Content (wet cast only)
E. Verification Samples: (2) pieces of actual cast stone components not less than 12 inches square, illustrating range of color and texture to be anticipated in components furnished for the project.
F. Source Quality Control Test Reports.
G. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications:
   1. A firm with a minimum of 10 years experience producing cast stone of types required for project.
   2. Producer shall follow Cast Stone Institute standards.
   3. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progression of the work.
   4. All products must contain Portland cement.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
B. Number each piece individually to match shop drawings and schedule.
C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
F. Store mortar materials where contamination can be avoided.
G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Architectural Cast Stone:
   3. MidCon Products: www.midconproducts.com
   5. MarcStone Cast Stone Co.: www.marcstone.com

2.02 ARCHITECTURAL CAST STONE

   1. Compressive Strength: As specified in ASTM C 1194 and ASTM C1364; 6500 psi minimum for products at 28 days.
   2. Water absorption: ASTM C 1195: 6% maximum by the cold water method, or 10% maximum by the boiling method for products at 28 days.
   3. Air Content – ASTM C173/C173M or C 231, for wet cast product shall be 4-8% for units exposed to freeze-thaw environments. Air entrainment is not required for VDT products.
   4. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C 1364. The CPWL shall be less than 5% after 300 cycles of freezing and thawing.
   5. Linear Shrinkage – ASTM C 426: Shrinkage shall not exceed 0.065%.
   6. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet.
   7. Color: Selected by Architect from manufacturer's full range.

B. Shapes: Provide shapes indicated on drawings.
   1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
   2. Unless otherwise indicated on drawings, provide:
      a. Wash or slope of 1:12 on exterior horizontal surfaces.
      b. Drips on projecting components, wherever possible.
      c. Raised fillets at back of sills and at ends to be built in.

C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.
   1. Pieces More than 12 inches Wide: Provide full length two-way reinforcement of cross-sectional area not less than 0.25 percent of unit cross-sectional area.

D. Reinforcement shall be noncorrosive where faces exposed to weather are covered with less than 1.5 in. of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.

E. Panels, soffits and similar stones greater than 24 in. (600 mm) in one direction shall be reinforced in that direction. Units less than 24 in. (600 mm) in both their length and width dimension shall be non-reinforced unless otherwise specified.

F. Welded wire fabric reinforcing shall not be used in dry cast products.

2.03 MATERIALS

A. Portland Cement: ASTM C150/C150M.
   1. For Units: Type I or II, white or grey.
   2. For Mortar: Type I or II, except Type III may be used in cold weather.

B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.

C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.

D. Pigments: ASTM C979/C979M, inorganic iron oxides; do not use carbon black.
E. Admixtures:
   1. ASTM C 260 for air entraining admixtures.
   2. ASTM C494/C494M Types A-G for water reducing, retarding, accelerating and high range admixtures.
   3. Other admixtures: integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
   4. ASTM C618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
   5. ASTM C989/C989M granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.

F. Water: Potable.

G. Reinforcing:
   1. ASTM C615/C615M. Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 in.
   2. Welded Wire Fabric: ASTM A 185/A where applicable for wet cast units.
   3. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304.

H. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized.
   1. Galvanized in accordance with ASTM A767/A767M, Class I.


J. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.

K. Shelf Angles and Similar Structural Items: Hot-dip galvanized steel per ASTM A123/A123M, of shapes and sizes as required for conditions.

L. Prefab corners as recommended by supplier.

M. Mortar: Portland cement-lime; do not use masonry cement.

N. Sealant: As specified in Section 07 92 00.

O. Flashings: Type as specified in Section 04 20 00.

P. Horizontal Weep/Vent: Cavity vent layed flat and spaced at 24 inches on center.
   1. Hohmann and Barnard; Quadro-Vent

Q. Cleaner: Approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.04 COLOR AND FINISH

A. Match PCI Color/Texture 141 AE-L.

B. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in. (0.8 mm) and the density of such voids shall be less than 3 occurrences per any 1 in.2 (25 mm2) and not obvious under direct daylight illumination at a 5 ft (1.5m) distance.

C. All exposed edges to be hand tooled to ensure a consistent quality edge.

D. Units shall exhibit a texture equal to the approved sample when viewed under direct daylight illumination at a 10 ft (3 m) distance.
   1. ASTM D2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
      a. Total color difference - not greater than 6 units.
      b. Total hue difference - not greater than 2 units.

E. All Cast Stone shall be hand sanded and acid washed with a 10% muriatic acid solution.

F. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.
2.05 SOURCE QUALITY CONTROL

A. Production Testing:
   1. Test compressive strength and absorption of specimens selected at random from plant production.
   2. Test in accordance with ASTM C642, ASTM C 1194 and C 1195.
   3. Samples shall be taken and tested from every 500 cubic feet of product produced.
   4. New and existing mix designs shall be tested for strength, absorption and freeze thaw compliance prior to producing units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 20 00.

B. Set units in mortar.

C. Setting:
   1. Drench cast stone components with clear, running water immediately before installation.
   2. Set units in a full bed of mortar unless otherwise indicated.
   3. Fill vertical joints with mortar.
   4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.03 TOLERANCES

A. Cross section dimensions shall not deviate by more than ±1/8 in. (3 mm) from approved dimensions.

B. Length of units shall not deviate by more than length/ 360 or ±1/8 in. (3 mm), whichever is greater, not to exceed ±1/4 in. (6 mm).
   1. Maximum length of any unit shall not exceed 12 times the average thickness of such unit unless otherwise agreed by the manufacturer

C. Warp, bow or twist of units shall not exceed length/ 360 or ±1/8 in. (3 mm), whichever is greater.

D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features; on formed sides of unit, 1/8 in. (3 mm), on unformed sides of unit, 3/8 in. (9 mm) maximum deviation.

3.04 CLEANING

A. Clean completed exposed cast stone after mortar is thoroughly set and cured.
   1. Wet surfaces with water before applying cleaner.
   2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
   3. Remove cleaner promptly by rinsing thoroughly with clear water.
   4. Do not use acidic cleaners.

END OF SECTION
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PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Structural steel framing members.
   B. Base plates, shear stud connectors.
   C. Grouting under base plates.

1.02 RELATED REQUIREMENTS
   A. Refer to Structural Drawings for additional design information.
   B. Section 04 20 00 - Unit Masonry: Coordination of application of bituminous coating to columns in masonry cavities.
   C. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
   D. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS
   H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
   P. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2009.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings:
      1. Indicate profiles, sizes, spacing, locations of structural members, openings, and attachments.
      2. Include erection plans, setting diagrams, erection details showing work required for structural steel framing installation, type of steel, details of structural members including cuts, connections, camber, holes, and other modifications to base member.
      3. Indicate type, size and length of bolts, distinguishing between shop and field bolts.
4. Indicate welds with standard AWS symbols, distinguishing between shop and field welds, and identifying size, length and type of weld.
5. Connections not detailed.
6. Indicate cambers and loads.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
E. Fabricator Test Reports: Comply with ASTM A1011/A1011M.
F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE
A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
B. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS
2.01 MATERIALS
A. Steel Angles, Plates, and Channels: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Rolled Steel Structural Shapes: ASTM A992/A992M.
D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
F. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
G. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.
H. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 or ASTM A325M, Type 1, medium carbon, plain, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers or ASTM A490 or ASTM A490M; Type 1 alloy steel, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.
I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
J. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
  1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
  2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
  3. Height Change, Plastic State; when tested according to ASTM C827/C827M:
     b. Minimum: Plus 1 percent.
K. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
L. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION
A. General
  1. Fabricate items of structural steel according to approved Shop Drawings. Fabrication from Shop Drawings not approved by the Engineer is at the sole risk of the Fabricator.
  2. Camber structural steel where noted. Where no camber is noted, beams shall be fabricated so that natural camber is upward in the erected condition.
  3. Perform thermal cutting by machine. For cut edges to be welded, comply with AWS D1.1.
  4. Combinations of bolts and welds on the same faying surface in the same connection are not permitted unless otherwise detailed.
  5. Required straightening of built-up sections shall be performed to minimize residual stresses.
6. Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members as shown on Structural Drawings or approved by Engineer.
7. Complete structural-steel assemblies before starting shop painting operations.

B. Shop fabricate to greatest extent possible.
C. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
D. Fabricate connections for bolt, nut, and washer connectors.

2.03 FINISH

A. Coordinate surface preparation with paint/coating requirements specified in Division 9 Paint Sections. Follow recommendations of paint/coating supplier.
B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
C. Apply structural steel primer paint in accordance with manufacturer's instructions, but in no case at a rate less than that which provides a uniform dry film thickness of 2.0 mils to 3.5 mils for interior unexposed steel or 2.5 mils to 3.5 mils for interior exposed and exterior steel.
D. Use painting methods which result in coverage of joints, corners, edges and exposed surfaces. Stripe paint corners, crevices, bolts, welds, and sharp edges. Stripe paint shall set to touch before applying primer coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 PREPARATION

A. Coat all steel surfaces below grade with bituminous coating.
B. At columns exposed in cavity walls or surrounded with masonry and having a cavity between the masonry, coat column with bituminous coating a minimum 24 inches above grade.

3.03 ERECTION

A. Erect structural steel in compliance with AISC Standards.
B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
C. Field weld components and shear studs indicated on shop drawings.
D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
E. Do not field cut or alter structural members without approval of Architect.
F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Roof deck.
   B. Supplementary framing for openings up to and including 18 inches.
   C. Bearing plates and angles.

1.02 RELATED REQUIREMENTS
   A. Refer to Structural Drawings for additional design information.

1.03 REFERENCE STANDARDS
   I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
   B. Product Data:  Provide deck profile characteristics, dimensions, structural properties, and finishes.
   C. Shop Drawings:  Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
   D. Certificates:  Certify that products furnished meet or exceed specified requirements.
   E. Submit manufacturer's installation instructions.
   F. Welders Certificates:  Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE
   A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Cut plastic wrap to encourage ventilation.
   B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Steel Deck:
      4. Substitutions:  See Section 01 60 00 - Product Requirements.
2.02 STEEL DECK
A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
   1. Calculate to structural working stress design and structural properties specified.
B. Roof Deck: Type B (Wide Rib); Non-composite type, fluted steel sheet:
   1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275
galvanized coating.
   2. Structural Properties:
      a. Span Design: 3 span condition minimum.
      b. Minimum Metal Thickness: See Structural Documents
      c. Nominal Height: 1-1/2 inch.
      d. Profile: Fluted; SDI B.
   3. Formed Sheet Width: 36 inch.
   5. End Joints: Lapped, welded.

2.03 ACCESSORY MATERIALS
A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
B. Welding Materials: AWS D1.1/D1.1M.
C. Fasteners: Galvanized hardened steel, self tapping.
D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply
    with applicable requirements of ICC-ES AC70.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable
      requirements of SDI (DM) design method for roof deck and floor deck applications and ICC-ES
      AC43.
   2. Material: Steel; ASTM A510/A510M.
      a. Hardness: Rockwell C 54.5, minimum.
      b. Tensile Strength: 285 kips per square inch, minimum.
      c. Shear Strength: 175 kips per square inch, minimum.
      d. Corrosion Resistance:
         1) Steel Bar Joist Framing Applications: ASTM B633, SC1, Type III.
         2) Exposed Roof Deck Applications: Provide manufacturer's standard stainless steel
            sealing caps with bonded neoprene washer over each fastener.
E. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping. 12 Teks/4, #12 Teks/5 or
   #12 Stitch Teks as required for condition of use.
F. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having
   jurisdiction.
H. End Closures: Where detailed shall be 16 gauge galvanized steel.
I. Side Closures: As required shall be same gauge and finish as deck.
J. Flute Closures: Closed cell foam rubber, 1 1/2 inch thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES
A. Sheet Metal Deck Accessories: Metal closure strips and cover plates, 20 gage, 0.0359 inch thick sheet
   steel; of profile and size as indicated; finished same as deck.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION
A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and
   level.
B. On steel supports provide minimum 1-1/2 inch bearing.
C. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
   1. Welding: Use fusion welds through weld washers.
D. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.
E. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
F. At welded male/female side laps weld at 18 inches on center maximum.
G. Weld deck in accordance with AWS D1.3/D1.3M.
H. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.
I. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.
J. Close openings above walls and partitions perpendicular to deck flutes with double row of foam cell closures.
K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud exterior wall framing.
B. Exterior wall sheathing.

1.02 RELATED REQUIREMENTS

A. Refer to Structural Drawings for additional design information.
B. Section 05 12 00 - Structural Steel framing: Structural building framing.
C. Section 07 21 00 - Thermal Insulation: Rigid insulation sheathing.
D. Section 07 25 00 - Weather Barriers: Weather barrier over sheathing.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
C. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2015.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
   1. Indicate stud layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
   3. Design data:
E. Design Calculations:
   1. Submit structural design with supporting calculations stamped by a Registered Professional Engineer in the State of which building is constructed for approval by Engineer.
   2. Design calculations for systems shall include design dead, live, and wind and seismic loads using load criteria as indicated on Drawings. Wind load design shall utilize components and cladding positive and negative wind loads per the 2015 IBC with Wisconsin Amendments and AISI Code for cold-formed materials. Include engineering analysis depicting stress and deflection requirements. Include design for connections and attachment to structure.
   3. The following design limits shall apply:
      a. Limit maximum simple span lateral deflection of studs supporting brick veneer to L/720 with the stud backup system alone taking lateral load. No composite action with sheathing or brick permitted.
      b. Limit spandrel panel cantilever projection deflection to L/360 at window head and sill. Limit vertical stud deflection to 1/8 inch at window head.
      c. Limit maximum simple span lateral deflection of studs supporting metal panels only to L/360.
d. The 0.42 factor, as noted in the 2015 IBC with Wisconsin Amendments Table 1604.3, shall not be permitted to be used for meeting deflection criteria as set forth in this Specification.

4. Design framing systems to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of 1 inch, plus or minus of primary building structure.

F. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
   3. Telling Industries: www.buildstrong.com
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:
   1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
   2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   3. Design Loads: In accordance with applicable codes.
   4. Live load deflection meeting the following, unless otherwise indicated:
      b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
      c. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.
   5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

C. Shop fabricate framing system to the greatest extent possible.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gage and Depth: As required to meet specified performance levels.
   2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.

B. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.

3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
   a. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
   b. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
   c. Acceptable Products: VertiClip(r) or DriftClip(tm) manufactured by The Steel Network Inc. or approved equal.


2.04 WALL SHEATHING
   A. Glass mat faced gypsum board; ASTM C1177/C1177M, square long edges, 5/8 inch thick, Type X - Fire Resistant.
      1. Glass-Mat-Faced Products:
         a. CertainTeed Corporation; GlasRoc Brand.
         b. Georgia-Pacific Gypsum; DensGlass Sheathing.
         c. National Gypsum Company; Gold Bond Brand eXP Extended Exposure Sheathing.
         d. Temple-Inland Building Products by Georgia-Pacific, LLC; GreenGlass Exterior Sheathing.
         e. USG Corporation; Securock Glass-Mat Sheathing.
         f. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORIES
   A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
   B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
      1. ZRC Worldwide; Galvilite. www.zrcworldwide.com

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that substrate surfaces are ready to receive work.
   B. Verify field measurements and adjust installation as required.
   C. Discrepancies:
      1. Immediately notify Architect of discrepancies.
      2. Do not proceed with installation in areas of discrepancies until such discrepancy has been fully resolved.

3.02 INSTALLATION OF STUDS
   A. Install components in accordance with manufacturers’ instructions and ASTM C1007 requirements.
   B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center.
   C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
   D. Install load bearing studs full length in one piece. Splicing of studs is not permitted.
   E. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
   F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
   G. Install intermediate studs above and below openings to align with wall stud spacing.
   H. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
I. Attach cross studs to studs for attachment of fixtures anchored to walls.

J. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

K. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 INSTALLATION OF WALL SHEATHING

A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.

1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.

END OF SECTION
SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Shop fabricated steel items.

1.02 RELATED REQUIREMENTS
A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.
C. Section 09 91 13 - Exterior Painting: Paint finish.
D. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS
K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
O. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE
A. Design applicable work under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Angles, Plates and Channels: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
D. Plates: ASTM A283/A283M.
E. Pipe For Handrails: ASTM A53/A53M, Grade B Schedule 40, black finish.
F. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
G. Welding Materials: AWS D1.1; type required for materials being welded.
H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Modification to existing roof ladder to allow for removable bottom portion. Remove ladder from bottom of safety cage. Add hangers to loop over rung at bottom of cage. Add bracket to bottom of removable ladder and WF column to allow for ladder to be pinned in place to WF. Refer to details on Drawing.
B. Bollards: Steel pipe; galvanized finish. Fabricated of 6” diameter Extra Strong steel pipe, ten feet long. Fill with concrete and set as detailed.
C. Bollard Covers: Polyethylene plastic pipe sleeves for steel pipe bollards. 0.25 inches thick. Shall contain ultraviolet protection additive. Five (5) Year UV stabilizer package. 5 year warranty. Color as selected by A/E from standard line.
   1. IdealShield, HDPE 1/8” thick. www.idealshield.com
   2. Innoplast, BollardGard Bollard Cover. www.innoplast.com
   3. Post Guard. www.postguard.com
D. Ledge Angles Not Attached to Structural Framing: For support of metal decking; prime paint finish.
E. Guard Rails: 1 1/4 inch nominal (1.66 inch O.D.) Black Schedule 40, round pipe unless otherwise indicated. Refer to drawing details for dimensions of intermediates and other details.
   1. End and Intermediate Posts: Same material and size as top rails.
      a. Horizontal Spacing: As detailed.
      b. Vertical Post Spacing: 5'-0" o.c. maximum.
      c. Mounting: Welded to top surface of structural member or inserted in sleeves set in concrete. See drawings.
F. Door Frames for Overhead Door Openings: Galvanized Bent Plate sections; prime paint finish.
2.04 STRUT SYSTEM
   A. Channel members used to support suspended equipment and other structural load situations.
   B. Manufacturer:
      1. Unistrut; www.unistrut.us
   C. Plain Carbon Steel: A 1011 SS Grade 33.
   D. Carbon Steel: All carbon steel fittings shall be fabricated from steel that meets/exceeds the physical
      requirements of ASTM A1011 SS Grade 33 and conforms to one of the following ASTM specifications.
      1. ASTM A 575
      2. ASTM A576
      3. ASTM A36/A36M
      4. ASTM A 635

2.05 FINISHES - STEEL
   A. Prime paint steel items.
      1. Exceptions: Galvanize items to be embedded in concrete and items to be imbedded in masonry,
      2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required,
         and items to be covered with sprayed fireproofing.
   B. Minimum preparation of surfaces to be primed in accordance with SSPC-SP2. Follow paint/coating
      supplier recommendations for required surface preparation.
   C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
   D. Prime Painting: One coat.
   E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
   F. Galvanize Repair: ZRC Worldwide; Galvilite. www.zrcworldwide.com

2.06 FABRICATION TOLERANCES
   A. Squareness: 1/8 inch maximum difference in diagonal measurements.
   B. Maximum Offset Between Faces: 1/16 inch.
   C. Maximum Misalignment of Adjacent Members: 1/16 inch.
   D. Maximum Bow: 1/8 inch in 48 inches.
   E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION
   A. Clean and strip primed steel items to bare metal where site welding is required.
   B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or
      embedded in masonry.

3.03 INSTALLATION
   A. Install items plumb and level, accurately fitted, free from distortion or defects.
   B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until
      completion of erection and installation of permanent attachments.
   C. Barrier Protection: Do not install over cementitious materials, dissimilar metals or pressure treated
      material without adequate barrier protection.
   D. Field weld components as indicated on drawings.
   E. Perform field welding in accordance with AWS D1.1/D1.1M.
   F. Obtain approval prior to site cutting or making adjustments not scheduled.
   G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to
      be in contact with concrete.
3.04 STRUT INSTALLATION

A. The installer shall inspect the work area prior to installation. If work area conditions are unsatisfactory, installation shall not proceed until satisfactory corrections are completed.

B. Installation shall be accomplished by a fully trained manufacturer authorized installer.

C. Set Strut System components into final position true to line, level and plumb, in accordance with approved drawings.

D. Anchor material firmly in place, and tighten all connections to their recommended torques.

END OF SECTION
SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-structural dimension lumber framing.
B. Rough opening framing for doors, windows, and roof openings.
C. Sheathing.
D. Structural composite lumber.
E. Roof-mounted curbs.
F. Roofing nailers.
G. Miscellaneous framing and sheathing.
H. Concealed wood blocking, nailers, and supports.
I. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 06 20 00 - Finished Carpentry: Finish items with wood blocking requirements.
B. Section 06 17 53 - Shop-Fabricated Wood Trusses.
C. Section 06 41 00 - Architectural Wood Casework: Wood blocking requirements for cabinet installation.
D. Section 06 61 00 - Cast Polymer Fabrications: Fiberglass grate installed over LVL framing.
E. Section 07 52 00 - Modified Bituminous Membrane Roofing

1.03 REFERENCE STANDARDS

C. APA - The Engineered Wood Association (APA):
   1. Plywood Design Specification
D. APA PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels (Form E445); 2001.
F. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide technical data on wood preservative materials.
C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch or Spruce-Pine-Fir, unless otherwise indicated.
   2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER

A. Sizes: Nominal sizes as indicated on drawings, S4S.
B. Moisture Content: S-dry or MC19.
C. Refer to Structural Drawings for design stresses.
D. Stud Framing (2 by 2 through 2 by 6):
   1. Species: Any allowed under referenced grading rules.
   2. Grade: No. 2.
E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 STRUCTURAL COMPOSITE LUMBER

A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
   1. Joists: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer’s published E (modulus of elasticity): 1,800,000 psi, minimum.
   2. Manufacturers:
      c. Louisiana-Pacific Corporation: www.lpcorp.com
      d. Timberweld Mfgr.: www.timberweld.com
      e. Structural Wood Corp.: www.structural-wood.com
      f. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 CONSTRUCTION PANELS

A. Roof Sheathing: Any PS 2 type, rated Structural I Sheathing.
   3. Performance Category: 5/8 PERF CAT.
B. Plywood Sheathing: For locations at roof parapets and caps: Plywood, PS 1, Grade CDX, Exterior Exposure. 3/4 inch unless noted otherwise.
C. Plywood Sheathing: Interior wall sheathing. Plywood, PS 1, Grade C-D, Exposure I. 1/2 inch unless noted otherwise

2.05 ACCESSORIES

A. Fasteners and Anchors:
   2. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
C. H-Clips: Metal H-clips for installation on roof plywood.
PART 3 EXECUTION

3.01 PREPARATION
A. Coordinate installation of rough carpentry members specified in other sections.
B. Where wood framing is in contact with concrete or masonry, separate wood with No.15 felt bond break.

3.02 INSTALLATION - GENERAL
A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03 FRAMING INSTALLATION
A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
C. Install structural members full length without splices unless otherwise specifically detailed.
D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS
A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
D. Provide the following specific non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Grab bars.
   3. Towel and bath accessories.
   4. Wall-mounted door stops.

3.05 ROOF-RELATED CARPENTRY
A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS
A. Miscellaneous Panels at Vertical and Horizontal Locations: Secure panels to framing members, with ends staggered (where applicable) and over firm bearing.
   1. Screw panels to metal or wood framing. Staples are not permitted
B. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. At long edges use sheathing clips where joints occur between roof framing members.
   2. Nail panels to framing; staples are not permitted.
   3. Install in accordance with recommendations of APA.
C. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails or screws.
   1. Install in accordance with recommendations of APA.
3.07 TOLERANCES
   A. Framing Members: 1/4 inch from true position, maximum.

3.08 CLEANING
   A. Waste Disposal:
      1. Comply with applicable regulations.
      2. Do not burn scrap on project site.
      3. Do not burn scraps that have been pressure treated.
      4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
   B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
   C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION
SECTION 06 17 53  
SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Shop fabricated wood trusses for roof framing.
   B. Bridging, bracing, and anchorage.

1.02 RELATED REQUIREMENTS
   A. Section 06 10 00 - Rough Carpentry: Installation requirements for miscellaneous framing.
   B. Section 06 10 00 - Rough Carpentry: Material requirements for blocking, bridging, plates, and miscellaneous framing.

1.03 REFERENCE STANDARDS
   A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 DESIGN REQUIREMENTS
   A. Comply with applicable code for structural loading criteria.

1.05 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Manufacturer's data sheets on plate connectors, bearing plates, and metal bracing components.
   C. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.

1.06 QUALITY ASSURANCE
   A. Truss Design, Fabrication, and Installation: In accordance with TPI 1, TPI DSB-89, and BCSI 1.
   B. Trusses are located in an interior location for teaching carpentry basics. Construct trusses to typical industry standards. Construction loads apply. No exterior loads required.
   C. Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Handle and erect trusses in accordance with TPI BCSI 1.
   B. Store trusses in vertical position resting on bearing ends.

PART 2 PRODUCTS
2.01 TRUSSES
   A. Wood Trusses: Designed and fabricated in accordance with TPI 1 and TPI DSB-89 to achieve structural requirements indicated.
      1. Connectors: Steel plate.

2.02 MATERIALS
   A. Lumber:
      2. Moisture Content: Between 7 and 9 percent.
   B. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) Grade 33/230, with G90/Z275 coating; die stamped with integral teeth; thickness as required.
   C. Truss Bridging: Type, size and spacing recommended by truss manufacturer.
2.03 ACCESSORIES
   A. Wood Blocking, Bridging, Plates, and Miscellaneous Framing: As specified in Section 06 10 00.
   B. Fasteners: Electrogalvanized steel, type to suit application.
   C. Bearing Plates: Electrogalvanized steel.

2.04 FABRICATION
   A. Fabricate trusses to achieve structural requirements specified.
   B. Brace wood trusses in accordance with TPI DSB-89 and BCSI 1.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that field measurements are as indicated.
   B. Verify that supports and openings are ready to receive trusses.

3.02 PREPARATION
   A. Coordinate placement of bearing items.

3.03 ERECTION
   A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and TPI BCSI 1; maintain a copy of each TPI document on site until installation is complete.
   B. Set members level and plumb, in correct position.
   C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.
   D. Do not field cut or alter structural members without approval of Architect.
   E. Install permanent bridging and bracing.
   F. Coordinate placement of decking with work of this section.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Specially fabricated cabinet units.
B. Countertops.
C. Hardware.
D. Preparation for installing utilities.
E. Slatwall

1.02 RELATED REQUIREMENTS
A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
B. Section 07 92 00 - Joint Sealants.
C. Section 08 14 16 - Flush Wood Doors: Sliding wood door.
D. Division 22 - Required plumbing fixtures and connections.
E. Division 26 - Required electrical fixtures and connections.

1.03 REFERENCE STANDARDS
B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
D. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate materials, component profiles and elevations of casework layout, assembly methods, joint details, fastening methods, accessory listings, rough-in locations, hardware location and schedule of finishes. Show details of countertop construction including backsplash, endspirit and edge details, and type of substrate core material.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
C. Product Data: Provide data for hardware accessories.
D. Samples: Plastic laminate surfacing in manufacturer's standard colors.
E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.05 QUALITY ASSURANCE
A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Protect units from moisture damage.

1.07 FIELD CONDITIONS
A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

1.08 WARRANTY REQUIREMENTS
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Delamination of components or other failures of glue bond.
      b. Warping of components.
      c. Failure of operating hardware.
      d. Deterioration of finishes.
   2. Warranty Period: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 CABINETS
   A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.02 LUMBER MATERIALS
   A. Cabinet Rib Materials, Base Frames and Kicks: Kiln dried hardwood or softwood with a moisture content of 5-10% or 3/4'' APA B-B G-2 Exp 1 exterior plywood. Construction lumber (s-dry) not allowed.

2.03 PANEL MATERIALS
   A. Particleboard: ANSI A208.1; medium density industrial type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, composed of wood chips bonded with waterproof resin binders under heat and pressure; sanded faces; thickness as required; use for countertops and back splash.
   B. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.
      1. Use for components not indicated as another material.
      2. Use as backing for plastic laminate unless otherwise indicated.

2.04 LAMINATE MATERIALS
   A. Manufacturers: Refer to Master Color Schedule on ID Drawings for basis of design.
      5. Substitutions: See Section 01 60 00 - Product Requirements.
   B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
      C. Provide specific types as indicated.
         1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, finish as indicated.
         2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, color as selected, finish as indicated.
         3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, through color, color as selected, finish as indicated.
         4. Post-Formed Vertical Surfaces: VGP, 0.028 inch nominal thickness, through color, color as selected, finish as indicated.
         5. Cabinet Liner: CLS, 0.020 inch nominal thickness (melamine), color as selected, finish as selected.
         6. Laminate Backer: BKL, 0.020 inch nominal thickness (melamine), undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.05 COUNTERTOPS
   A. Plastic Laminate Countertops: Medium density industrial particle board substrate covered with HPDL. Back/end splash shall be coved joint. Countertop edge shall be post formed with self edge economy.
2.06 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.
B. Plastic Edge Banding: Extruded 3mm PVC, flat shaped; smooth finish; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer’s full range.
   2. Use at all door, drawer and front edge of shelves (except wood shelves receive hardwood edge) and all face frames.
C. Fasteners: Size and type to suit application.
D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threaded steel.
F. Slat Wall: 4 x 8 foot plastic laminate slat wall sheets with brackets for shelves as detailed. Shelves by Owner.
   1. 6 inch on center horizontal grooves with aluminum inserts.
   2. Aluminum brackets.
      b. www.panel.com
      c. Substitutions: See Section 01 60 00 - Product Requirements.
G. Countertop Support Brackets: Prefinished metal support brackets with predrilled holes, sized to fit countertop depth minus 3 inches.
   d. Woodworkers Hardware; www.hardware.com

2.07 HARDWARE

A. Hardware: BHMA A156.9, types as indicated for quality grade specified.
B. Adjustable Shelf Supports: Double pin side-mounted system using multiple holes for pin supports and coordinated shelf rests, for nominal 1 inch spacing adjustments. Load rating to be 300 lbs. per support without failure.
   1. Product: #55 Double Pin or HD Double Pin manufactured by Allenfield Manufacturing and Development.
   2. Shelf Support Clip #3220CL from Bainbridge Manufacturing Inc.
C. Drawer and Door Pulls: U-shaped, 4” centers.
   1. Product: BP5352ORB, brushed stainless steel finish, manufactured by Hafele.
   2. Or comparable.
D. Catches: Magnetic. Install one at base and wall cabinets.
   1. Product: 326 Mighty Might Heavy Duty Magnetic Latch or comparable, manufactured by Ives.
E. Drawer Slides:
   1. Type: Combination metal and roller bearing, three-quarter extension.
   2. File Drawers: Combination metal and roller bearing, full extension with over travel, 150 lb. Accuride 4034 Series or comparable.
   3. Wide Shelf Application: Accuride 7950 or comparable.
   4. All other drawers: 100 lb.
      a. Manufacturers:
         1) Blum; Product 230 Series or comparable by;
      b. Substitutions: See Section 01 60 00 - Product Requirements.
F. Hinges: 5 knuckle type, institutional style, hospital tipped, stainless steel with satin finish.
   1. Manufacturers:
      c. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 FABRICATION

A. Cabinet Style: Flush overlay.

B. Base Cabinets:

C. Wall Cabinets:
   1. Underside of wall cabinets shall be Type "C" flush with finish applied after assembly.
   2. Provide manufacturer's standard construction to reinforce cabinets for wall attachment, minimum two, full width 3/4" thick x 3", glued and mechanically fastened at cabinet back.

D. Drawer Construction Technique: dovetail or doweled.
   1. Bottoms and Sides: 1/2" Veneer core panel product, "B" face hardwood veneer or 1/2" medium density fiberboard with thermoset decorative overlay. PVC edge banding at exposed edges.
   2. Bottoms shall be dadoed into sides, front and back. Staple and glue.
   3. Reinforcement; 1/2 inch thick under-bottom stiffeners, one at 24 inch drawers, two at 36 inch drawers and four at 48 inch drawers.

E. Shelves-3/4": Finish to match inside face of cabinet. All shelves shall be full depth of cabinet.
   1. Particleboard with Plastic Laminate Finish Both Sides: 40 lb limit to 37" long. 50 lb limit to 35 inches.
   2. Medium Density Fiberboard with Plastic Laminate Finish Both Sides: 40 lb limit to 37" long. 50 lb limit to 35 inches.

F. Shelves-1": Finish to match inside face of cabinet. All shelves shall be full depth of cabinet.
   1. Particleboard with Plastic Laminate Finish Both Sides: 40 lb limit to 45" long. 50 lb limit to 43 inches.
   2. Medium Density Fiberboard with Plastic Laminate Finish Both Sides: 40 lb limit to 45" long. 50 lb limit to 43 inches.

G. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

H. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

I. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

J. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Where countertop length exceeds manufacturer's maximum sheet length Locate counter butt joints minimum 2 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

K. Mechanically fasten back splash to countertops with steel brackets at 16 inches on center.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.
D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
E. Secure cabinets to floor using appropriate angles and anchorages.
F. Coordinate placement of fixtures and items required in other divisions.
G. Where casework meets wall surfaces, set with uniform space not to exceed 1/8 inch. Seal all joints to a slightly concave joint. Use backer rod where required. Refer to Section 07 92 00 for sealant type.

3.03 SLAT WALL INSTALLATION
A. Installer's Examination: Refer to Section 08 14 16 for door to receive slat wall. Examine conditions under which construction activities of this section are to be performed. Submit written notification to Architect and system manufacturer if such conditions are unacceptable. Beginning erection constitutes installer's acceptance of conditions.
1. Verify backing panels are smooth, solid, and flat. All drywall joints are to be taped and finished.
2. Verify that walls are primed before installation begins.
3. Verify mechanical, electrical, and building service and/or items affecting work of this section are placed and ready to receive this work.
4. Verify that stud spacing does not exceed 24" (600mm) on-center.
B. Building shall be completely closed. Walls shall be thoroughly dry before starting installation.
C. Install all materials in strict accordance with the manufacturer’s installation instructions with hardware straight, plumb, and level.
1. Anchor units rigidly and securely in place.
2. Cut sheets to meet existing supports
D. Fasten initial bottom panel to the wall with recommended screws. Install a minimum of one screw every third slot (or 9" (228mm)) vertically and every stud horizontally, typically every 16" (40.64cm) on centers horizontally (maximum 24" (600mm) on centers horizontally). Each 4' x 8' panel shall have minimum of 42 screws secured to studs or furring.
1. Where screws do not hit the studs, fasten with adhesive in accordance with the manufacturer’s recommendations.
2. Screws must be installed thru the panel grooves.
3. Slatwall panels without inserts do not require pre-drilling.
4. Slatwall panels with inserts require 5/32" pre-drilling of holes thru the insert and panel before fastening.
E. Avoid contamination of the panel faces with adhesives, solvents or cleaners during installation.

3.04 ADJUSTING
A. Adjust installed work.
B. Adjust moving or operating parts to function smoothly and correctly.

3.05 CLEANING
A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION
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PART 1  GENERAL
1.01  SECTION INCLUDES
   A. Solid surface window sills
   B. Fiberglass grates.

1.02  RELATED REQUIREMENTS
   A. Section 06 10 00 - Rough Carpentry: Framing to support fiber glass grates.
   B. Section 07 92 00 - Joint Sealers.

1.03  REFERENCE STANDARDS

1.04  SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on cast fabricated units.
   C. Product Data: Provide data on specified grating indicating sizes and product handling.
   D. Samples: Submit two samples of solid surface representative of , 6x6 inch in size, illustrating color, texture, and finish.
   E. Manufacturer's Installation Instructions: Indicate preparation of opening required, rough-in sizes; tolerances for item placement, temporary bracing of components.
   F. Maintenance Data: Indicate list of approved cleaning materials and procedures required; list of substances that are harmful to the component materials.
      1. Include instructions for stain removal, surface and gloss restoration.
   G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05  QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06  WARRANTY
   A. Correct defective Work within a two year period after Date of Substantial Completion.

PART 2  PRODUCTS
2.01  MANUFACTURERS: ALL ITEMS LISTED SHALL BE SINGLE SOURCE. REFER TO MASTER COLOR SCHEDULE ON ID DRAWINGS FOR BASIS OF DESIGN COLORS.
   A. Solid Surface Fabrications: 100 percent acrylic resin, meeting ANSI Z124.3, Type 6. Product shall have consistent color through its cross section. Vanities and windowsills shall be single sourced.
   B. Includes window sills as detailed. Refer to Master Color Schedule on ID Drawings for basis of design. Comparable products by prior approval from:
      1. Avonite; www.avonite.com
      2. Corian; www.dupont.com/dupont-corian surfaces
      3. Meganite; www.meganite.com
      4. Wilsonart; www.wilsonart.com
      5. Substitutions: See Section 01 60 00 - Product Requirements.
   C. Window Sills: One piece 1/2 inch solid color composite material with eased front edge.
      1. Gel coat the finish exposed surfaces smooth and polish to a low sheen.
2.02 MATERIALS
A. Cast Polymer:
   1. Provide finished products having flame spread index of 35 and smoke developed index of 15, when tested in accordance with ASTM E84 in thickness of 3/4 inch.
   2. Resin: Proprietary; integrally-colored, stain-resistant and resistant to domestic chemicals and cleaners.
   3. Filler Material: ASTM E84 Class A rated.
   4. Polishing Cream: Compatible polishing cream to achieve specified sheen to gel coat.
   5. Adhesive: Manufacturer's standard, two part type, cartridge dispensed.

2.03 FIBERGLASS GRATES
A. 1 1/2 inch high by 1 1/2 inch molded square, dark gray color, molded fiberglass grating.
B. Manufacturer:
   2. Or comparable.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that field measurements are as indicated.
B. Verify that joint preparation and affected dimensions are acceptable.

3.02 INSTALLATION
A. Install window sills with recommended adhesive. Seal perimeter with clear silicone.

3.03 GRATE INSTALLATION
A. Field verify extents of grating and spacing of supports. Size lengths and widths for efficient use of material.
B. Lay grate in-place to allow access to space below at locations identified on Drawings. Support ends at framing members.

3.04 CLEANING
A. Clean and polish surfaces in accordance with manufacturer's instructions.

3.05 PROTECTION
A. Do not permit construction near unprotected surfaces.
B. After setting protect window sills with non-staining, easily removed covering.
C. Replace damaged and defective work.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY
A. Section includes the furnishing and installation of specified plastic trim products of PVC or polyurethane, including but not limited to:
   1. Trim Boards

1.02 RELATED REQUIREMENTS
A. Section - 06 10 00 - Rough Carpentry
B. Section - 07 46 33 - Plastic Siding
C. Section - 07 92 00 - Joint Sealants

1.03 REFERENCED STANDARDS
A. ASTM D256- Determining the Pendulum Impact Resistance of Plastics.
B. ASTM D570- Water Absorption of Plastics.
C. ASTM D635- Rate of Burning and/or Extent of Time of Burning of Plastics in a Horizontal Position.
D. ASTM D638- Tensile Properties of Plastics.
E. ASTM D1761- Mechanical Fasteners in Wood.
   1. Fabricated Ornamental Trim
F. ASTM D2863- Limited Oxygen Index.
G. ASTM D5420- Impact Resistance of Flat, Rigid Plastic Specimen by means of a Striker Impacted by a Falling Weight.

1.04 DESIGN / PERFORMANCE REQUIREMENTS:
A. Tolerances - Finished surfaces for PVC flatness and cupping shall not vary more than >1/4 inch in 10 feet (3 mm in 3.05 m) and squareness 1/8 inch corner to corner when tested with a straight edge and shall be free from cracks, pits, chips, voids, depressions, bumps, ridges, waves, scratches, discoloration, and of other defacements.
B. Products in this section shall comply with all requirements stipulated in the 2009 IBC.
C. Trim shall be designed, engineered, fabricated and installed to conform to all state and local codes and the project drawings and specifications

1.05 SUBMITTALS:
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer’s data sheets on each product to be used including: storage and handling requirements and recommendations; preparation instructions and recommendations and installation methods.
C. Product Samples: For each finish profile and product specified, provide two samples representing the actual profile, product, pattern and finish specified. One set of approved samples will be returned to the contractor.
D. Manufacturer’s Certificates: Provide manufacturer’s documentation to certify products submitted meet or exceed specified requirements.
E. Test Reports: Submit manufacturer’s test reports for trim products from an accredited independent testing agency.

1.06 QUALITY ASSURANCE:
A. Manufacturer Qualifications: Manufacturer shall have not less than 10 years successful experience in producing the type of prefabricated components required for project applications equivalent to the requirements for this project.
B. Installer Qualifications: Installer shall have a minimum of 5 years experience installing the type of prefabricated components specified.
1.07 DELIVERY, STORAGE AND HANDLING:
A. Deliver all materials in original packaging, unopened with no visible damage.
B. Label each package with product contents and stock number of contents, with warranty, installation, handling and storage recommendations enclosed, on-line or on packaging.
C. Allow for receiving, unloading, handling, and movement to approved storage areas within the project, and final movement to point of installation.
D. Store and protect all materials in accordance with manufacturer’s requirements for environmental and physical protection. Keep temporary protective covering in place.
E. Store products on flat level surface to prevent warping.
F. Protect materials and finish from damage during handling and installation.

1.08 PROJECT CONDITIONS:
A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s recommendations.
B. Field Measurements: Verify actual measurements and openings by field measurements before fabrication. Show recorded measurements on shop drawings.
C. Allow at least 24 hours for materials to adapt to conditions at project site prior to installation.
D. Protect uncoated portions of materials from ultraviolet exposure.

1.09 WARRANTY:
A. Upon completion of work, provide a written Manufacturer’s Limited Warranty for products installed as part of this project to the Original Owner.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
B. CertainTeed Corp.: www.certainteed.com/products/trim
C. Azek Building Products: www.azek.com
D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS:
A. Manufactured trim shall be homogenous and free of voids, cracks and foreign inclusions and other defects. Edges must be square and top and bottom surfaces shall be flat with no convex or concave deviations.
B. Manufactured trim and sheets:
   1. Trim Size: 3/4 inch x dimensions as detailed.

2.03 ACCESSORIES:
A. Fasteners:
   1. Use stainless steel, smooth shank, screw, annular threaded, or spiral nails. Hot dip galvanized nails may also be used.
   2. Staples, small brads wire nails and ring shank nails not allowed.
   3. Fasteners should be long enough to penetrate the substrate a minimum of 1 inch.
   4. Use of power nail guns is acceptable when adjusted to prevent overdriving the nail into the product.
   5. Use two fasteners per every framing member of trim board applications. Use additional fasteners for trim boards 12 inches or greater.
   6. Install fasteners no more than 2 inches from the end of the board
   7. Fasten trim into a flat, solid substrate. Fastening trim into hollow or uneven areas must be avoided.
   8. Pre-drilling is recommended when using large fasteners or if product is being installed in temperatures below 40 degrees F.
9. Adhesives:
   a. Glue all trim joints with a cellular PVC cement/adhesive approved by the manufacturer.
   b. Glue joints should be secured with a fastener and/or fastened on each side of the joint to allow adequate bonding time.
   c. Surfaces to be glued should be smooth, clean and in complete contact with each other.

10. Sealants:
   a. Urethane, polyurethane or acrylic based sealants without silicone as specified in section 07 92 00.

2.04 FINISHES
   A. When factory finish is available, A/E shall select from full line of colors.
   B. If factory finish is not an option:
      1. Product shall have a protective barrier coat primer, resistant to UV degradation, providing interim UV protection of products. Refer to Section 09 91 13 for field paint finish.

PART 3 - EXECUTION

3.01 EXAMINATION:
   A. Site Verification of Conditions.
      1. Prior to the start of installation, inspect all preceding work to ensure that there are no conditions which will cause an unsatisfactory installation of work that would affect performance of installed trim.
      3. Do not install any work involving trim products until unsatisfactory conditions are corrected and acceptable for proper installation of work.
      4. Contractor shall be responsible for correcting or replacing all unacceptable work involving trim products, which was installed over unsatisfactory conditions at no cost to Owner.

3.02 PREPARATION:
   A. Protect surrounding and adjacent work as required to prevent damage to preceding work during execution of this work.
   B. Perform all preparation necessary for a successful installation of products as specified in manufacturer’s installation instructions.

3.03 INSTALLATION:
   A. Comply with manufacturer’s written instructions applicable to the products and applications indicated in this section.
   B. Coordinate installation of products with other contractors and provide proper accommodation for following work by other trades.
   C. Cutting:
      1. Use blades that are designed for cutting wood or plastic.
      2. Carbide tipped blades are recommended. Fine tooth blades
      3. Drilling:
         a. Use standard wood or metal drill bits.
         b. Avoid heat build up from friction.
         c. Drill bits designed for drilling rigid PVC pipe should not be used.
      4. Routing:
         a. Use standard router bits machining the product.
         b. Multi-fluted carbide bits are recommended.
      5. Edge Finishing:
         a. Edges can be finished by sanding, grinding or filing with standard woodworking tools.
      6. Nail Location:
         a. Minimum of 16 inch center nailing pattern to studs shall be used.
         b. Fasteners shall be kept ¾ inch away from the board edge and staggered slightly to reduce the chance of cracking along the line of fasteners as the material expands and contracts.
7. **Gluing:**
   a. All joints shall be glued to prevent joint separation. Provide fasteners on each side of the joint to allow adequate bonding time.
   b. Whenever possible, adhesives should be applied to the backside of the trim at the joints to help hold the trim at the joints forcing it to expand and contract in the center preventing unsightly gaps at the joints.
   c. When bonding together two smooth or non-machined surfaces of the PVC board clean the surfaces with acetone.
   d. On long lengths of trim, like corner boards or fascia, a scarf joint should be used.

8. **Thermal Expansion and Contraction:**
   a. Allow 3/16 inch per 18 foot for expansion and contraction.

9. **Sealant:**
   a. Install sealant as specified in section 07 92 00.

10. **Finishing:**
    a. For small blemishes, file holes with an approved exterior spackling.
    b. For larger holes or gaps, fill with an approved urethane acrylic sealant.
    c. Trim may be painted to achieve a custom color. Choose a paint color with a Light Reflectance Value (LRC) of 55% or higher to avoid excessive solar heating of installed products. Using paint with a LRV of 54% or lower will void the product warranty. Refer to Section 09 91 13.
    d. Follow paint manufacturer’s recommendations for applying paint.

11. **Adhesives:**
    a. Install adhesives at trim joints and for fastening in accordance with manufacturer’s recommendations for proper installation of products. Use only adhesives approved for use by manufacturer.

3.04 **FIELD QUALITY CONTROL:**
   A. After installation, check all work for flaws and defects.
   B. Repair all defective work.
   C. Remove and replace all damaged components that cannot be successfully repaired as determined by the Project Architect.

3.05 **PROTECTION:**
   A. Install temporary protective materials necessary to prevent significant damage to materials installed in this work. Remove protection when required to permit project completion.

3.06 **CLEANING:**
   A. Remove all labels and protection materials.
   B. Clean all surfaces following manufacturer’s recommendations prior to final project completion. Do not use harsh cleaning materials or methods that would damage finish.
   C. Dispose properly of all debris generated by this work, protection materials and cleaning materials.

END OF SECTION
SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Board insulation at perimeter foundation wall.

1.02 RELATED REQUIREMENTS
A. Section 07 42 16 - Metal Wall Panel/Rain Screen Assembly: Air barrier and mineral fiber insulation installed at all exterior locations.
B. Section 07 55 00 – 2 Ply Modified Built-up Roofing: Roof Insulation.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. Manufacturer’s Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS
A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.06 SEQUENCING
A. Sequence work to ensure air barrier materials are in place before beginning or continuation of work in this section.

PART 2 PRODUCTS

2.01 APPLICATIONS
A. Insulation at Perimeter of Foundation: Extruded polystyrene or expanded polystyrene board.

2.02 FOAM BOARD INSULATION MATERIALS
A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   6. Type and Water Absorption: Type XI, 4.0 percent by volume, maximum, by total immersion.
   7. Manufacturers:
      a. ACH Foam Technologies: www.achfoam.com
      b. AFM Corp: www.r-control.com/#sle.
      d. Plymouth Foam: www.plymouthfoam.com
      e. Substitutions: See Section 01 60 00 - Product Requirements.
B. Extruded Polystyrene Board Insulation (Foundation): ASTM C 578, Type IV; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Board Thickness: As noted on drawings.
   4. Manufacturers:
      a. Dow: Styrofoam XPS
      c. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.
d. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.

e. DiversiFoam Products: www.diversifoam.com

f. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FOAMED-IN PLACE JOINT AND CREVICE FILLER INSULATION

A. Insulation joint and gap filler.
   1. PUR FILL Fireblock Foam: www.todol.com
   5. Dow; Great Stuff Pro: www.greatstuff.dow.com
   6. Convenience Products: Touch 'n Seal. 800-325-6180
   7. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.

   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Apply expanding sealant to edges or install board with shiplap edges.
   4. Butt edges and ends tightly to adjacent boards and to protrusions.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane. Fill all gaps and voids with expanding foam insulation.

3.03 JOINT AND CREVICE FILLING FOR AIR SEALING

A. Low Rise Expanding Foam: Where applicable install low rise foam to fill gaps and crevices. Follow manufacturer recommendations at windows and doors to prevent swelling of frames and causing doors or windows to become inoperable.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Foamed-in-place insulation.
   1. In exterior stud framed walls.

1.02 RELATED REQUIREMENTS
A. Applicable provisions of Division 1 shall govern the work of this section.
B. Section 05 40 00 - Cold Formed Framing.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
C. Documentation that applied product is compatible with all substrates installed on the project.
D. Certificates: Certify that products of this section meet or exceed specified requirements.
E. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
F. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
G. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
H. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.
I. Daily work record reports.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
   1. Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified closed cell, medium density spray polyurethane foam. Obtain secondary materials from a source acceptable to the primary materials manufacturer.
B. Air Barrier Subcontractor Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA) whose Installer(s) are certified in accordance with the site Quality Assurance Program used by ABAA.
   1. Closed cell, medium density sprayed polyurethane foam air barrier Installer(s) shall be certified by BPQI (Building Performance Quality Institute) for the ABAA Quality Assurance Program in accordance with the requirements outlined in the QAP program used by ABAA. Installers shall have their photo-identification air barrier certification cards in their possession and available on the project site, for inspection upon request.
1.06 PRECONSTRUCTION MEETING
   A. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction and testing of mock-up, sequence of construction, coordination with substrate preparation, compatibility of materials, use of scaffolding, lifts and staging and details of construction and chemical/fire safety plans. Attendance is required by representatives of related trades including covering materials, substrate materials and adjacent materials.

1.07 REGULATORY REQUIREMENTS
   A. Conform to applicable code for flame and smoke limitations.

1.08 DELIVERY, STORAGE AND HANDLING
   A. Deliver materials to Project site in original packages with seals unbroken, labeled with the material manufacturer’s name, product, date of manufacture, and directions for storage.
   B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.
   C. Handle materials in accordance with material manufacturer’s recommendations.

1.09 FIELD CONDITIONS
   A. Sequence work to ensure timely placement of insulation within construction spaces.
   B. Do not apply foam when the temperature is below that specified by the manufacturer for ambient air and substrate or when temperature is within 5 degrees F of dew point.
   C. Sequencing. Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.

1.10 WARRANTY
   A. Material Warranty: Provide primary material manufacturer’s standard product warranty, from date of Substantial Completion.
   B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a two (2) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of cohesion/adhesion and failure to cure properly.

PART 2 PRODUCTS
2.01 MATERIALS
   A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
      1. Aged Thermal Resistance: R-value of 5 (deg F hr sq ft)/Btu, minimum, when tested at 1 inch thickness in accordance with ASTM C518 after aging for 180 days at 41 degrees F.
      2. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
      3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
      4. Air Permeance: 0.04 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.57 psf.
      5. Closed Cell Content: At least 90 percent.
      6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
    
    7. Manufacturers:
       b. Demilic (USA) Inc.: Demilic XT-w. www.demilic.com
       c. Gaco Western; GacoOnePass F1850R: www.gaco.com/#sle.
       d. Henry Company; Permax 0.5: www.henry.com/#sle.
       e. Icynene-Lapolla; Icynene ProSeal: www.icynene.com/#sle.
       g. Lapolla Industries, Inc; Foam-Lok 2000-4G. www.lapolla.com
       h. Rhino Linings Corporation; ThermalGuard CC2: www.rhinolining.com/#sle.
       i. NCFI Polyurethane; ThermalStop or InsulStar. www.ncfi.com
       j. CertainTeed Corporation; CERTASPRAY CC. www.certainteed.com
       k. Substitutions: See Section 01 60 00 - Product Requirements.
PART 3 EXECUTION

3.01 EXAMINATION

A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with Construction Manager, ABAA Certified Installer present, for compliance with the following requirements.
   1. Confirm site access logistics and scheduling requirements.
B. Verify work within construction spaces or crevices is complete prior to insulation application.
C. Verify that surfaces are clean, dry, and free of excess mortar or other matter that may inhibit insulation adhesion.
   1. Inspect substrates to be smooth without large voids or sharp protrusions. Inform Construction Manager if substrates are not acceptable and need to be repaired by the concrete sub-trade.
   2. Verify substrate is visibly dry and free of moisture.
   3. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
   4. Notify Construction Manager in writing of anticipated problems using closed cell, medium density spray polyurethane foam over substrate prior to proceeding.

3.02 PREPARATION

A. Provide all personal protective equipment for duration of product application.
B. Mask and protect adjacent surfaces from over spray or dusting.
C. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.
D. Apply primer in accordance with manufacturer's instructions. Confirm application rate on sheathing to determine effective rate of application.
   1. Prime glass-fiber surfaced gypsum sheathing with an adequate number (if applicable) of coats to achieve required bond, with adequate drying time between coats.
   3. Clean galvanized metal of oil residue.
   4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and protrusions.
E. Install polyethylene or similar bond break at piping and other protrusions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by spray method, to a uniform monolithic density without voids.
C. Apply to a minimum cured thickness of 2 inch. An additional pass of 2.0 inches (50 mm) shall only be done after the first pass has had time to cool down. At no time shall more than 4.0 inches (100 mm) be installed in a single day. There are no exceptions to this requirement as it is a health and safety requirement.
D. Install within material manufacturer's tolerances, but not more than minus ¼ inch (6 mm).
E. Finished surface of foam insulation to be free of voids and embedded foreign objects.
F. Inspect installation prior to enclosing assembly and repair damaged areas with closed cell, medium density spray polyurethane foam as recommended by manufacturer.
G. Where applied to voids and gaps, assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
H. Trim excess away for applied trim or remove as required for continuous sealant bead.
3.04 FIELD QUALITY CONTROL
   A. Insulation applicator shall perform the following tests:
      1. Adhesion
      2. Cohesion
      3. Thickness
      4. Density
   B. Insulation applicator shall complete daily inspection reports as required by ABAA using approved work record forms.

3.05 PROTECTION AND CLEANING
   A. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
   B. Do not permit subsequent construction work to disturb applied insulation.
   C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

END OF SECTION
SECTION 07 22 00

ROOF DECK INSULATION

PART 1 - GENERAL

SEE DETAILED ROOF DRAWINGS FOR SPECIFICS

1.2 RELATED SECTIONS

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

B. Related work specified elsewhere:
   1. Section 07 55 00 – 2 Ply Modified Built-up Roofing
   2. Section 07 62 00 - Sheet Metal Flashing and Trim

1.3 REFERENCES

ASTM A-167-94a  Specification for Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet and Strip
ASTM A-653  Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
ASTM B-29  Pig Lead
ASTM B-32  Solder Metal
ASTM C-165-95  Test Method for Measuring Compressive Properties of Thermal Insulation
ASTM C-208-95  Specifications for Cellulosic Fiber Insulating Board
ASTM C-209-92  Test Method for Cellulosic Fiber Insulating Board
ASTM C-272-91  Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C-36  Specification for Gypsum Wallboard
ASTM C-578-92  Specification for Rigid, Cellular, Polystyrene Thermal Insulation
ASTM C-728-91  Specification for Perlite Thermal Insulation Board
ASTM D-5  Test Method for Penetration of Bituminous Materials
ASTM D-36  Test Method for Softening Point of Bitumen (Ring and Ball Apparatus)
ASTM D-312  Specification for Asphalt Used in Roofing
ASTM D-412-92  Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
ASTM D-1621-94  Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D-1622  Test Method for Apparent Density of Rigid Cellular Plastics
ASTM D-1863  Specification for Mineral Aggregate Used on Built-Up Roofs
ASTM D-2126-94  Test Method for Response of Rigid Cellular Plastics to Thermal Humid Aging
ASTM D-2178  Standard Specification for Asphalt Glass Felts used in Roofing and Waterproofing
ASTM D-4601-94  Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D-5147  Sampling and Testing Modified Bituminous Sheet Material
CISPI  Cast Iron Soil Pipe Institute, Washington, D.C.
FM  Factory Mutual System, Norwood, Massachusetts
NRCA  National Roofing Contractors Association, Chicago, IL
SMACNA  Sheet Metal and Air Conditioning Contractors National Association
SDI  Steel Deck Institute, St. Louis, Missouri
SPIB  Southern Pine Inspection Bureau, Pensacola, Florida
UL  Underwriter's Laboratories, Inc., Northbrook, Illinois
FS HH-I-1972  Insulation Board, Polyisocyanurate
FS LLL-1-535B  Insulation Board, Thermal (Fiberboard)
WH  Warnock Hersey International, Inc., Middletown, Wisconsin

1.4 SUBMITTALS

A. Submit under provisions of Section 01300 - Submittals.

B. Product Data: Provide manufacturer’s specification data sheets for each product in accordance with Section 01 30 00.
C. Provide approval letters from insulation manufacturer for use of their insulation within this particular roofing system type.

D. Shop Drawings
1. Submit shop drawings indicating complete installation details of tapered insulation system, including identification of each insulation block, sequence of installation, layout, drain locations, roof slopes, thicknesses, crickets and saddles.
2. Shop drawing shall include: Outline of roof, location of drains, complete board layout of tapered insulation components, thickness and the average “R” value for the completed insulation system.

E. Certification
1. Submit roof manufacturer’s certification that insulation fasteners furnished are acceptable to roof manufacturer.
2. Submit roof manufacturer’s certification that insulation furnished is acceptable to roofing manufacturer as a component of roofing system and is eligible for roof manufacturer’s system warranty.

1.5 QUALITY ASSURANCE
A. Fire Classification, ASTM E-108
B. Submit certification that the roof system furnished is approved by Factory Mutual, Underwriters Laboratories or Warnock Hersey for external Fire E-108 Class 1A.

1.6 DELIVERY, STORAGE AND HANDLING
A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.
B. Store all insulation materials in a manner to protect them from the wind, sun and moisture damage prior to and during installation. Any insulation that has been exposed to any moisture shall be removed from the project site.
C. Keep materials enclosed in a watertight, ventilated enclosure (i.e. tarpaulins).
D. Store materials off the ground. Any warped, broken or wet insulation boards shall be removed from the site.

PART 2 – PRODUCTS
2.1 APPROVED EQUIVALENT
A. Contractor must submit any product not specified to be considered for approval. The Owner’s Representative will notify contractor in writing of decision to accept or reject request.

2.2 INSULATION MATERIALS
A. Provide thicknesses of insulation as indicated, provide combination of types and thickness’ to provide a complete system.

1. POLYISOCYANURATE ROOF INSULATION
a. Qualities: Closed cell polyisocyanurate foam core bonded to heavy duty glass fiber mat facers.
   1. Average R-Value:
      Average R-Value = 36, including existing insulation, new polyisocyanurate and wood fiber recovery board.
   b. Insulation board shall meet the following requirements
      1. UL, WH or FM listed under Roofing Systems
      2. Federal Specification HH-I-1972, Class 1
   c. Physical Properties
      Dimensional Stability  ASTM D-2126  2% max.
      Compressive Strength  ASTM D-1621  20 psi min.
      Vapor Permeability    ASTM E-96  1 perm max.
      Foam Core Density     ASTM D-1622  2.0 pcf min.
      Water Absorption      ASTM C-209  <1%
      R-Factor HR per inch  ASTM C-518  5.6 (Design Value)
2. HIGH DENSITY FIBERBOARD ROOF INSULATION
   a. Qualities: Rigid, composed of interlocking fibers factory blended treated with asphalt on the top side.
      1. Board Size: 4’ x 8’, 4’ x 4’, or 4’ x 2’.
      2. Thickness: Minimum ½ in.
   b. Insulation board shall meet the following requirements
      1. UL, WH, FM listed under Roofing Systems.
   c. Physical Properties
      | Property                  | ASTM       | Value   |
      |---------------------------|------------|---------|
      | Dry Density               | C-208      | 17.5 pcf. |
      | Compressive Strength      | C-165      | 45 psi min. |
      | Linear Expansion          | C-208,209  | 0.5% max. |
      | Foam Core Density         | C-1622     | 2.0 pcf min. |
      | Water Absorption          | C-208      | 10% max. |
      | R-Factor HR per inch      |            | 5.6     |
      | Thickness                 | C-518      | 2.5 (Design Value) |

2.3 RELATED MATERIALS
   A. Fiber Cant and Tapered Edge Strips: Performed rigid insulation units of sizes/shapes indicated, matching insulation board or of perlite or organic fiberboard, as per the approved manufacturer.
   B. Protection Board: Pre-molded semi-rigid asphalt composition board ½ in.
   C. Roof Board Joint Tape: 6” wide glass fiber mat with adhesive compatible with insulation board facers.
   D. Asphalt: ASTM D-312, Type III Steep Asphalt.
   E. Fasteners:
      1. Corrosion resistant screw fastener as recommended by roof membrane manufacturer.
      2. Factory Mutual Tested and Approved with 3 in. coated disc for 1-60 rating, length required to penetrate metal deck one inch.
      3. Minimum pull out resistance of 800 lbs.
      4. Olympic Style NTB Gyp deck fastener or approved equal.
      5. Olympic-Heavy Duty Fastener or approved equal.
      6. Simplex – Lite-Deck Fastener or approved equal.

PART 3 – EXECUTION
3.1 INSPECTION OF SURFACES
   A. Roofing contractor shall be responsible for preparing an adequate substrate to receive insulation.
      1. Verify that work penetrating roof deck has been completed.
      2. Verify that wood nailers are properly and securely installed.
      3. Examine surfaces for defects, rough spots, ridges, depressions, foreign material, moisture, and unevenness.
      4. Do not proceed until defects are corrected.
      5. Do not apply insulation until substrate is completely dry.
      6. Broom clean substrate immediately prior to application.
      7. Use additional insulation to fill depressions and low spots that would otherwise cause ponding water.
      8. Verify that temporary roof has been completed.

3.2 INSTALLATION
   A. Attachment with Mechanical Fasteners.
      1. Approved insulation board shall be fully attached to the deck with an approved mechanical fastening system. As a minimum, the amount of fasteners shall be in accordance with manufacturer’s recommendation for FM 1-60 approved system. Otherwise, a minimum of one fastener per four square feet shall be installed.
2. Filler pieces of insulation require at least two fasteners per piece if size of insulation is less than four square feet.
3. Spacing pattern of fasteners shall be as per manufacturer’s recommendations to meet the FM requirements. Placement of any fastener from edge of insulation board shall be a minimum of three inches, and a maximum of six inches.
4. Minimum penetration into deck shall be as recommended by the fastener manufacturer. There is a one inch (1") minimum for metal, wood and structural concrete decks where not specified by the manufacturer. For gypsum and cement-wood fiber decks, penetration shall be determined from pull-out test results with a minimum penetration of one and one-half inches (1-1/2").
5. Gypsum and cementitious wood fiber decks: Where the roof deck is visible from the building interior, the contractor shall ensure no penetration of fasteners through underside of the deck. Any holes or spalling caused by fastener installation shall be repaired by the roofing contractor. Where the new roof system thickness exceeds an amount so that a minimum of 1-1/2" of penetration cannot be achieved with an Olympic NTB Fastener, or approved equivalent, then (and only then) toggle bolts may be used to secure installation to the deck.

B. **Attachment using Hot asphalt.**
   1. Over the entire deck surface, prime concrete surfaces with asphalt primer at the rate of 1 (one) gallon per one hundred (100) square feet.
   2. Embed one layer of rigid insulation board in solid moppings of hot asphalt at the rate and temperature recommended by insulation manufacturer. Stagger end joints of boards so all open joints will be eliminated. Walk in each piece of insulation and leave boards completely adhered to deck. Each insulation board shall be butt firmly against adjoining panels. All open joints shall be eliminated.
   3. Approved recovery board one-half (½) inch thickness shall be installed over base tapered insulation using hot asphalt at the rate of approximately thirty (30) pounds per square.
   4. All boards shall be cut and fitted where the roof deck intersects a vertical surface. The boards shall be cut to a minimum of one-quarter (¼) inch away from the vertical surface.
   5. Install no more insulation at one time than can be roofed on the same day.
   6. Install temporary water cut-offs at completion of each day’s work and remove upon resumption of work.
   7. Cant Strips/Tapered Edge Strips: Install preformed forty five (45) degree cant strips at junctures of vertical surfaces. Provide preformed, tapered edge strips at perimeter of edges of roof that do not terminate at vertical surfaces and/or indicated on the drawings. Tape joints of insulation as per manufacturer’s requirements.

3.3 **CLEANING**
   
   A. Remove debris and cartons from roof deck. Leave insulation clean and dry, ready to receive roofing membrane.

**END OF SECTION**
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Asphalt shingle roofing.
   B. Associated metal flashings and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 06 10 00 - Rough Carpentry: Roof sheathing.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data indicating material characteristics.
   C. Samples: Submit two samples of each shingle color indicating color range and finish texture/pattern; for color selection.
   D. Manufacturer's Installation Instructions: Indicate installation criteria and procedures.
   E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
   F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. See Section 01 60 00 - Product Requirements, for additional provisions.
      2. Extra Shingles: 30 sq ft of each type and color.

1.05 FIELD CONDITIONS
   A. Do not install shingles or eave protection membrane when surface temperatures are below 45 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Asphalt Shingles:
      1. GAF: www.gaf.com/sle.
      2. IKO Industries Inc: www.iko.com/#sle.
      4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ASPHALT SHINGLES
   A. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462/D3462M.
      1. Weight: 30 lb/100 sq ft.
      2. Self-sealing type.
      3. Style: Square, 3-tab.

2.03 SHEET MATERIALS
   A. Underlayment: Asphalt-saturated organic roofing felt, unperforated, complying with ASTM D226/D226M, Type I ("No.15").

2.04 ACCESSORIES
   A. Roofing Nails: Standard round wire shingle type, galvanized steel, minimum 3/8 inch head diameter, 12 gage, 0.109 inch nail shank diameter, 1-1/2 inch long and complying with ASTM F1667.
2.05 METAL FLASHINGS
   A. Metal Flashings: Provide sheet metal eave edge and gable edge.
      1. Form flashings to protect roofing materials from physical damage and shed water.
      2. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions prior to beginning work.
   B. Verify that roof deck is of sufficient thickness to accept fasteners.
   C. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.02 PREPARATION
   A. At areas where eave protection membrane is to be adhered to substrate, cover knot holes with sheet metal.
   B. Broom clean deck surfaces before installing underlayment or eave protection.
   C. Install eave edge flashings tight with fascia boards, weather lap joints 2 inches and seal with plastic cement, and secure flange with nails spaced 12 inches on center.

3.03 INSTALLATION - UNDERLAYMENT
   A. Underlayment At Roof Slopes Greater Than 4:12: Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum 4 inches, stagger end laps of each consecutive layer, nail in place, and weather lap minimum 4 inches over eave protection.
   B. Weather lap and seal watertight with plastic cement any items projecting through or mounted on roof.

3.04 INSTALLATION - METAL FLASHING AND ACCESSORIES
   A. Install flashings in accordance with manufacturer’s instructions.
   B. Weather lap joints minimum 2 inches and seal weather tight with plastic cement.
   C. Secure in place with nails at 12 inches on center, and conceal fastenings.
   D. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.

3.05 INSTALLATION - SHINGLES
   A. Install shingles in accordance with manufacturer’s instructions and NRCA (RM) applicable requirements.
   B. Place shingles in straight coursing pattern with 5 inch weather exposure to produce double thickness over full roof area, and provide double course of shingles at eaves.
   C. Project first course of shingles 1/4 inch beyond roof edge flashing.
   D. Extend shingles 1/4 inch beyond face of gable roof edge flashing.

END OF SECTION
SECTION 07 42 16
METAL WALL PANEL / RAINSCREEN ASSEMBLIES

1. GENERAL

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related work specified elsewhere:
   1. Section 04 20 00 – Unit Masonry: Cavity wall areas receiving air barrier and mineral fiber insulation specified herein.

2. SUMMARY.

A. Work described in this section includes the following:
   1. Self-Adhering Vapor Permeable Air and Water Barrier (AWB): including all necessary sheet goods, flashing, tapes, mastics, and sealants to insure a complete water resistive, vapor permeable air barrier wall system
   2. Thermal Building Insulation
   3. Metal Wall Panels: single-skin, labyrinth-joint metal cladding panels for rainscreen-principle wall system, complete with sub-structural metal framing, perimeter and penetration flashing, and closures

B. Related work specified elsewhere:
   1. Section 05 40 00 – Cold Formed Framing: Steel studs and exterior sheathing.
   2. Section 06 10 00 – Rough Carpentry: Wood blocking and sheathing.
   3. Section 07 62 00 – Sheet Metal Flashing and Trim: Flashing and sheet metal for installations other than metal panels.

3. DEFINITIONS

A. American Architectural Manufacturer Association (AAMA):
   1. AAMA 509-09: Voluntary Test and Classification Method for Drained and Back Ventilated Rain Screen Wall Cladding Systems.
   2. AAMA 508-07: Voluntary Test and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.

B. American Iron and Steel Institute (AISI):
C. American Society for Testing and Materials (ASTM):
   2. A653-03: Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   10. E1886-02: Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

D. European Norm (EN):

E. National Association of Architectural Metal Manufacturers (NAAMM)
   1. Metal Finishes Manual for Architectural and Metal Products.

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

4. DESIGN & PERFORMANCE CRITERIA - Self-Adhering Vapor Permeable AWB
   A. General Performance: Self-Adhering Vapor Permeable Air and Water Barrier system shall be furnished and installed without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   B. Air Leakage
      1. The self-adhering air barrier shall have less than 0.01 cfm/ft² of air leakage when tested in accordance with ASTM E2357.
      2. The self-adhering air barrier shall have less than 0.0040 cfm/ft² at 1.57 psf when tested in accordance with ASTM E2178.
      3. The self-adhesive air barrier and metal cladding panel specified in Division 07 shall be jointly tested as an assembly in accordance with ASTM E283 with an air leakage rate of less than 0.04 cfm/ft² at 1.57 psf
C. Water Resistance
   1. The self-adhering air barrier shall be tested for water resistance in accordance with AATCC 127 with a result of No Leakage after 5 hours with a 21.5-inch hydrostatic water head.
   2. The self-adhesive air barrier and metal cladding panel specified in Division 07 shall be jointly tested as an assembly in accordance with ASTM E331 with no uncontrolled leakage at 1.57 psf and 6.24 psf.

D. Vapor Permeance: The self-adhering air barrier shall be vapor permeable with a minimum vapor transmission rate of 50 perms when tested in accordance with ASTM E96, Method B.

E. Physical Properties
   1. Low Temperature Flexibility: The self-adhering air barrier shall demonstrate acceptable low temperature flexibility in accordance with the requirements of ASTM D1970.
   2. Bend Test: The self-adhering air barrier shall demonstrate acceptable bend flexibility in accordance with the requirements of ICC AC38 3.3.4.
   3. Peel Adhesion: The self-adhering air barrier shall exhibit a 90 degree peel adhesion in accordance with AAMA 711-5.3 and ASTM D3330.
   4. Wet Adhesion: The self-adhering air barrier shall demonstrate acceptable adhesion after immersion in water in accordance with the requirements of AAMA 711-5.8.
   5. Puncture Resistance: The self-adhering air barrier shall demonstrate a minimum puncture resistance of 75 lbf in accordance with ASTM E154.
   6. Elevated Temperature: The self-adhering air barrier shall be suitable for use at an elevated temperature of 176ºF in accordance with the requirements of AAMA 771-5.5 and ASTM D3330 Level 3.
   7. Breaking Strength: The self-adhering air barrier shall have a minimum breaking strength and elongation at break of 70 lbf/in and 25% in the machine direction, and a minimum of 65 lbf/in and 60% in the cross-machine direction when tested in accordance with ASTM D5034.
   8. Tearing Strength: The self-adhering air barrier shall have a minimum trapezoidal tearing strength of 21 lbf/in in the machine direction, and a minimum of 14 lbf/in in the cross-machine direction when tested in accordance with ASTM D4533.
   9. Linear Dimensional Change: The self-adhering air barrier shall be have a change in linear dimension at elevated temperatures in accordance with ASTM D1204 of no more than 1.5% in the machine direction and 0.1% in the cross-machine direction.
   10. Crack Bridging Ability: The self-adhering air barrier shall have a demonstrated ability to bridge cracks in the substrate material in accordance with the requirements of ASTM C1305 at a temperature of -15ºF.
   11. Cyclical Thermal Change: The self-adhering air barrier shall demonstrate acceptable performance for thermal cycling in accordance with the requirements of AAMA 711-5.6.

F. Surface Burning Characteristics: The self-adhering air barrier shall have be rated as Class A material with a flame spread rating of less than 15 and a smoke-development index of less than 50 when tested in accordance with ASTM E84.
5. DESIGN AND PERFORMANCE CRITERIA – Thermal Board Insulation

A. General Performance: Continuous exterior rigid mineral fiber board thermal insulation shall satisfy all requirements of ASTM E612, Type IV-B, shall be free of defects, and meet each of the performance requirements specified herein.

B. Thermal Resistance:
   1. At 25ºF, the R-value per inch thickness shall be 4.3 hr·ft²·ºF/BTU minimum, in accordance with ASTM C518/C177.
   2. At 75ºF, the R-value (RSI-value) per inch (25.4mm) thickness shall be 3.9 hr·ft²·ºF/BTU minimum, in accordance with ASTM C518/C177.

C. Fire and Heat Performance:
   1. Surface Burning Characteristics: Flame spread rating shall be 0 and smoke development rating shall be 0 when tested in accordance with ASTM E84.
   2. Combustibility: The board insulation shall be rated as “Non-Combustible” when tested in accordance with ULC S114.
   3. The board insulation shall not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat at 1,382ºF, in accordance ASTM E136.
   4. The board insulation shall be considered Non-Combustible when tested in accordance with NFPA 268, and shall be deemed to be acceptable for use in exterior walls of Type I, II, III, and IV building construction without any constraints, such as use of a thermal barrier, as may be required by NFPA 285.
   5. The board insulation shall be rated for a 1,200ºF service temperature, as determined by testing in accordance with ASTM C411.

D. Moisture Resistance:
   1. Water absorption, as measured in accordance with ASTM C209, shall not exceed 1.2%.
   2. Water vapor sorption, as measured in accordance with ASTM C1104, shall not exceed 0.30%.
   3. Water vapor transmission, as measured in accordance with ASTM E96, shall be at least 40 perms.

E. Dimensional Stability and Physical Properties:
   1. The board insulation shall have a minimum density of 11.0 pcf as measured in accordance with ASTM C612.
   2. The board insulation shall have a minimum compressive strength of 1,220 psf at 10% maximum deformation when tested in accordance with ASTM C165.
   3. The board insulation shall have a maximum of 0.38% linear shrinkage at 1,200ºF when tested in accordance with ASTM C356.
   4. The board insulation shall exhibit dimensional stability of a maximum linear change of 0.1% after 7 days in accordance with ASTM D2126 at each of the following climate conditions:
      a. 40ºF with ambient relative humidity;
      b. 200ºF with ambient relative humidity;
      c. 158ºF with 97% relative humidity.
F. Acoustical Performance: When tested in accordance with ASTM C423, a 2-inch insulation board shall have a NRC rating of 0.85 minimum.

G. Corrosion Resistance:
   1. The insulation board shall be rated “Non-corrosive” to steel when tested in accordance with ASTM C665.
   2. The insulation board shall conform with the requirements of ASTM C795 with respect to corrosion resistance in contact with stainless steel materials.

6. DESIGN AND PERFORMANCE CRITERIA – Metal Wall Panels

   A. General Performance: Metal wall panel assemblies shall be furnished and installed without failure due to defective manufacture, fabrication, installation, or other defects in construction.

   B. Rain screen Wall System Performance Rating. The metal wall panel assemblies, and the sub-structural furring/framing system supporting the panels shall be tested in accordance with AAMA 509 and achieve the following performance results:
      1. Water Infiltration: The water infiltration performance of the metal wall panel assembly shall not exceed the classification of W-1.
      2. Back Ventilation: The air ventilation performance of the rain screen cavity air space shall have a minimum classification of V-4.

   C. Rain screen Wall System Performance Rating. The metal wall panel assemblies, and the sub-structural furring/framing system supporting the panels shall be tested in accordance with AAMA 508-07 and achieve the following performance results: PASS.

   D. Thermal Expansion and Contraction.
      1. Completed metal wall panel and flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, or reducing performance ability.
      2. The design temperature differential shall be not less than 220 degrees Fahrenheit.
      3. Interface between panel and clip shall provide for unlimited thermal movement in each direction along the longitudinal direction.

   E. Uniform Wind Load Capacity.
      1. Installed wall system shall withstand negative wind pressures complying with the following criteria.
         b. Safety Factor: The metal panel system shall be tested to proof load of 1.5 times the design service load condition, as required by the ASTM E330 method.
      2. The ultimate capacity of the panel system shall be determined based on performance testing in accordance with ASTM E330. The system shall be tested to a proof load that shall be 1.5 times the allowable design service load.

7. SUBMITTALS.

   A. General, Rain Screen Wall Assembly Components: Complete submittals shall be made jointly and simultaneously for all components of the Rain Screen wall assembly, including:
      1. Air and water resistive barrier
      2. Rain screen wall continuous exterior insulation
3. Metal rain screen wall cladding panels and sub-framing components
4. All other trim, flashing, sealants, and components necessary for a complete rain screen wall assembly as required by these specifications.

B. Shop drawings.
1. Show complete rain screen wall system with air and water barrier, continuous exterior insulation, sub-framing system, metal cladding panels, ventilation components, flashings and accessories in elevation, sections, and details. Include metal thicknesses and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations. Indicate relationships with adjacent and interfacing work.
2. All components shall be integrated into a single comprehensive and complete shop drawing set prepared by the metal cladding system manufacturer.
3. Shop drawings shall identify each product and component by manufacturer, product name, and thickness, size, style, or other uniquely distinguishing characteristics.

C. Warranty: Provide unexecuted specimen warranty documents for each warranty as specified.

D. Design Test Reports.
1. Submit copies of specified design test reports for each of the performance testing standards.
2. Test reports shall be performed by independent, accredited testing laboratories, and shall bear the seal of a registered professional engineer.

E. Samples.
1. Submit sample of panel section, at least 6" x 6" showing seam profile, and also a sample of color selected.
2. Submit sample field applied sealants and all other system components.

8. QUALITY CRITERIA/INSTALLER QUALIFICATIONS.
A. Engage an experienced metal wall panel contractor (erector) to install wall panel system who has a minimum of three (3) years experience specializing in the installation of rain screen metal wall systems.
B. Contractor must be certified by manufacturer specified as a supplier of the metal wall system and obtain written certification from manufacturer that installer is approved for installation of the specified system.
C. Successful contractor must obtain all components of rain screen wall system from a single manufacturer. Any secondary products that are required which cannot be supplied by the specified manufacturer must be recommended and approved in writing by primary manufacturer prior to bidding.
D. Fabricator/Installer shall submit work experience and evidence of adequate financial responsibility. Architect reserves the right to inspect fabrication facilities in determining qualifications.
9. DELIVERY, STORAGE, AND HANDLING.
   A. Inspect materials upon delivery.
   B. Handle materials to prevent damage.
   C. Store materials off ground providing for drainage; under cover providing for air circulation and preventing direct UV exposure; and protected from any debris.

10. PROJECT CONDITIONS
   A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal wall panel work to be performed according to manufacturer's written instructions and warranty requirements.
   B. Field Measurements: Verify actual dimensions of construction contiguous with metal wall panels by field measurements before fabrication.

11. COORDINATION
   A. Coordinate sizes and locations of windows, doors, and wall penetrations with actual equipment provided.
   B. Coordinate metal wall cladding system with wall sheathing, masonry, air and water resistive barriers, thermal insulation, rain drainage work, flashing, trim, and construction of other adjoining work to provide a leak proof, secure, and noncorrosive installation.

12. WARRANTIES
   A. Endorse and forward to owner the following warranties:
      1. Special Rain Screen System Water Tightness Warranty: The water-resistive air barrier supplier shall provide a ten (10) year warranty from date of Substantial Completion against uncontrolled water leakage to the interior of the building. The warranty shall identify by manufacturer, product name, and model number each component of the Rain Screen wall system, including each of those components specified herein.
      2. Manufacturer's standard material warranty in which manufacturer agrees to provide replacement material for the vapor permeable air and water barrier installed in accordance with manufacturer's instructions that fails due to material defects within three (3) years of the date of Substantial Completion.
      3. Exterior metal cladding system Manufacturer’s 20 year warranty for performance of prefinished finishes. The finish warranty shall provide coverage for the following:
         a. Fade Resistance: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit no more than a 5 “delta E” rating for color change from original color standard.
         b. Chalk Resistance: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit a chalk rating of 8 or less, in accordance with ASTM D4214, Method A.
         c. Film Integrity: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall not chip, peel, crack, or blister as a result of defective coatings, improper preparation of the substrate, improper application of the coatings, or improper curing of the coating system.
4. Exterior metal cladding system Manufacturer’s warranty for performance of Post-painted aluminum finishes. The finish warranty shall provide coverage for the following:
   a. Fade Resistance: For a period of 10-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit no more than a 5 “delta E” rating for color change from original color standard.
   b. Chalk Resistance: For a period of 10-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit a chalk rating of 8 or less, in accordance with ASTM D4214, Method A.
   c. Gloss Retention: For a period of 10-years from date of first exposure to UV or weathering, the post-painted material finishes shall retain at least 50% of original Specular Gloss, as measured in accordance with ASTM D523.
   d. Film Integrity: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall not chip, peel, crack, or blister as a result of defective coatings, improper preparation of the substrate, improper application of the coatings, or improper curing of the coating system.

5. Installer’s 3 year warranty covering wall panel system installation and watertightness.

B. Warranties shall commence on date of substantial completion.

13. SPECIAL INSPECTIONS

A. Air and water barrier manufacturer shall provide scheduled field inspections which shall include written reports. Inspections shall be conducted by a full time employee of the air and water barrier manufacturer. A third party inspector, approved by the air and water barrier manufacturer, is also acceptable. The field inspector reserves the right to review and report to the project architect the level of acceptability of work completed and to subsequently issue a report of items not acceptable—if required. Do not cover Work of this Section until testing and inspection is accepted.

B. Remove and replace applications of air and water barrier membrane system where inspections indicate that they do not comply with specified requirements.

2. PRODUCTS

1. PANEL MATERIALS – Metal Plate Wall Panels
   A. Painted Metal Plate Aluminum Sheet.
      1. Recycle Content: Provide steel sheet with average recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content is at least 45 percent.
      2. 0.080” aluminum alloy 3003, 3004, 3005, or 3105 with H14 or H24 heat treatment, as per ASTM B209/209M.
      3. Texture: Smooth surface.
      4. Prefinished Painted Aluminum:
         a. Exposed Surfaces: 2-Coat Fluoropolymer finish in accordance with AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Manufacturers’ approved applicator to prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions.
b. Exposed surface coating system shall provide nominal 1.0 mil (0.025 mm) dry film thickness, consisting of primer and color coat.

c. Color shall be selected from IMETCO’s Silver or Wood Grain Colors as approved by the project Architect and/or Owner.

d. Concealed Finish: Apply pretreatment and manufacturer’s standard white or light-colored polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Sealants:

1. Sealant Tape: Non-curing, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1-inch- (13-mm-) wide and 1/16-inch- (3-mm-) thick.

2. Exposed Sealant: ASTM C 920; elastomeric triopolymer, polyurethane, or other advanced polymer sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.


2. AIR AND WATER BARRIER

A. Air Barrier Membrane Materials.

1. The basis of design shall be IntelliWrap SA by Innovative Metals Company, Inc. (IMETCO), Norcross, Georgia (678) 656-1265.

2. Alternate manufacturers are subject to full compliance with specification requirements, and shall be submitted for approval as follows.

   a. Manufacturers not listed above must submit for approval, ten (10) days prior to bid date, the following: Manufacturer's literature; certification of testing in accordance with specification requirements and sections 1.4 and 1.5; sample warranties in accordance with specification section 1.10; installer qualifications in accordance with specification section 1.6, and a list of five (5) similar projects in size and scope of work.

   b. In addition to the above requirements, requests for substitute systems shall be accompanied by a notarized letter from a corporate officer of the system manufacturer stating that the proposed alternate complies with the warranty requirements of this section.

   c. No substitutions will be permitted after the bid date of this project.


4. Thickness: 26 mils.

5. Weight: 30 lbs.

6. Allowable UV Exposure: 50 days.

7. Application Temperature. Ambient temperature must be above 40 °F.

8. Service Temperature: -13 °F to 176 °F.

B. Air Barrier Transition and Flashing Membrane.
   1. Transition and flashing air barrier membrane shall be IntelliWrap Flashing SA by IMETCO, a self-adhering, water-resistive, vapor permeable membrane flashing sheet with properties the same as those of the Air Barrier Membrane.
   2. Roll Dimensions: 4-inches or 9-inches wide by 75-ft long.

C. Air Barrier Flashing and Penetration Tapes: Tapes shall be IntelliWrap Tape by IMETCO, a UV stabilized double or single sided moisture-resistant flexible tape with adhesive backing having the following characteristics:
   1. IntelliWrap Tape Single-Sided: 2.5-inches wide penetration seam tape.

D. Preformed Window and Door Corners: Preformed window and door flashing membrane shall be IntelliWrap SA Factory Formed Corners by IMETCO, an 18-inch by 18-inch preformed 90º inside corner membrane with the same vapor permeance, resistance to air leakage, and physical properties as the primary air barrier membrane.

E. Fasteners: Water resistive air barrier fasteners shall be as follows:
   1. Metal frame construction: Use 1-5/8” corrosion resistant screws with 2-inch diameter plastic caps or supplier approved 1-1/4” or 2” gasketed washers.
   2. Wood frame construction: Use #4 nails with 1-inch diameter plastic caps.
   3. Metal frame construction: Use 3/16” diameter corrosion resistant screws masonry screws with 2-inch diameter plastic caps.

3. THERMAL BUILDING INSULATION
   A. Mineral fiber rigid board insulation:
      1. The basis of design shall be ROXUL ComfortBoard 110 by Innovative Metals Company, Inc. (IMETCO), Norcross, Georgia (678) 656-1265.
      2. The following manufacturers can be considered, but shall be subject to the same performance requirements listed herein this specification:
         a. Thermafiber
         b. VaproShield
   3. Alternate manufacturers are subject to full compliance with specification requirements, and shall be submitted for approval as follows.
      a. Manufacturers not listed above must submit for approval, ten (10) days prior to bid date, the following: Manufacturer's literature; certification of testing in accordance with specification requirements and sections 1.4 and 1.5; sample warranties in accordance with specification section 1.10; installer qualifications in accordance with specification section 1.6, and a list of five (5) similar projects in size and scope of work.
      b. In addition to the above requirements, requests for substitute systems shall be accompanied by a notarized letter from a corporate officer of the system manufacturer stating that the proposed alternate complies with the warranty requirements section 1.10 A. of this specification.
      c. No substitutions will be permitted after the bid date of this project.
   4. Material: Basalt rock and slag mineral fiber board insulation, Type IV-B in accordance with ASTM C612.
5. Thickness: 2 layers of 1.5-inch
6. Insulation board size shall be 24-inches x 48-inches or 48-inches x 72-inches.

4. METAL SUBFRAMING
   A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653, G90 (Z275) hot-dip galvanized
   B. Horizontal Hat-shaped Vented Girts:
      1. The basis of design shall be Vented Hat Channel by Innovative Metals Company, Inc. (IMETCO), Norcross, Georgia (678) 656-1265.
      2. Alternate manufacturers are subject to full compliance with specification requirements, and shall be submitted for approval as follows.
         a. Manufacturers not listed above must submit for approval, ten (10) days prior to bid date, the following: Manufacturer's literature; certification of testing in accordance with specification requirements and sections 1.4 and 1.5; sample warranties in accordance with specification section 1.10; installer qualifications in accordance with specification section 1.6, and a list of five (5) similar projects in size and scope of work.
         b. In addition to the above requirements, requests for substitute systems shall be accompanied by a notarized letter from a corporate officer of the system manufacturer stating that the proposed alternate complies with the warranty requirements section 1.10 A. of this specification.
         c. No substitutions will be permitted after the bid date of this project.
   3. Dimensions:
      a. Nominal Thickness: 0.043-inch (18 gauge) (1.1-mm) nominal thickness.
      b. Depth: 1-inch (22 mm) nominal.
      c. Top flange: 2-5/8 inches (63.5 mm) nominal.
      d. Bottom Flanges: 1-1/2 inches (38 mm) nominal with 1/4 inch (6 mm) holes punched at 8” on center in each flange.
   4. Free air flow: The vented girt shall not restrict chimney effect air convection in the vertical direction. The vented girt webs shall have slotted holes providing for 31% free air flow and weep holes for water drainage.
   5. Drainage: Web segments of vented girt shall be formed such that when installed in the horizontal orientation the web segments are inclined at least 15 degrees from horizontal to promote drainage and prevent retention of standing water.
   6. Provide certified testing report by 3rd party independent testing lab showing the loading of the subgirt attached directly through the insulation. The max deflection of such test should be no more than 1/16”.
   C. Fasteners for Metal Subraming: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal subframing members through insulation and sheathing boards into structural wall framing or substrates.

5. METAL PLATE WALL PANELS - **TYPE 2 & TYPE 4 PANELS**
   A. General: Provide factory-formed metal wall panels designed to be field assembled by interlocking seams incorporating concealed anchor clips, allowing thermal movement.
B. Concealed clip, lap-seam wall panels

1. Panel shall be IMETCO Element wall system as manufactured by Innovative Metals Company, Inc. (IMETCO), Norcross, Georgia, telephone (678) 656-1265.
   a. **Type 2:** IMETCO; Element Panel, Silver. 16 inches high by 8 foot long, horizontal installation.
   b. **Type 4:** IMETCO; Element Panel, Wood Grain. 14 inches high by 6 foot long, vertical installation.

2. The following manufacturers can be considered, but shall be subject to the same performance requirements listed herein this specification:
   a. Dri Design
   b. Pohl

3. Alternate manufacturers are subject to full compliance with specification requirements, and shall be submitted for approval as follows.
   a. Manufacturers not listed above must submit for approval, ten (10) days prior to bid date, the following: Manufacturer's literature; certification of testing in accordance with specification requirements and sections 1.4 and 1.5; sample warranties in accordance with specification section 1.10; installer qualifications in accordance with specification section 1.6, and a list of five (5) similar projects in size and scope of work.
   b. In addition to the above requirements, requests for substitute systems shall be accompanied by a notarized letter from a corporate officer of the system manufacturer stating that the proposed alternate complies with the warranty requirements section 1.10 A. of this specification.
   c. No substitutions will be permitted after the bid date of this project.

C. General: Provide factory-formed metal wall panels designed to be field assembled by interlocking seams and incorporating concealed fasteners.

D. Concealed clip, longitudinal lap-seam panel with labyrinth-joint and reveal on four sides.

1. Panel shall be IMETCO ELEMENT Wall system as manufactured by Innovative Metals Company, Inc. (IMETCO), Norcross, Georgia. Local Rep – Anthony Chiarizio (678) 656-1265.

2. Material: Aluminum sheet, 0.080 inch (0.2.0 mm) thick. See 2.1 for finishes and color selection.

3. Characteristics.
   a. Fabrication: Panels shall be factory formed from specified metal.
   b. The standard profile shall be flat pans with reveal joints on all four sides.
   c. Panel orientation: Horizontal.
   d. Configuration: Panel shall be 20-inches- (610-mm-) high nominal by 60-inches-(1,525-mm-) long nominal, with interlocking seams incorporating concealed fasteners.
   e. Panel Depth (Concealed Leg Height): 1.25 inch, nominal.
   f. Reveal Joint: Panel seams shall join such that adjacent panels form vertical and horizontal reveal joints 3/4-inch- (19-mm-) wide.
1) Horizontal reveal joints shall be aligned from panel to panel, as shown on drawings.

2) Vertical reveal joints shall be aligned from panel to panel, as shown on drawings.

6. METAL WALL PANELS - **TYPE 1 & TYPE 3**

A. General: Provide factory-formed metal wall panels designed to be field assembled by interlocking seams incorporating concealed anchor clips, allowing thermal movement.

B. Concealed clip, lap-seam wall panels.
   1. Panel shall be IMETCO LATITUDE Wall system as manufactured by Innovative Metals Company, Inc. (IMETCO), Norcross, Georgia, telephone (678) 656-1265.
      a. **Type 1:** Latitude Panel; LW12S-6FB. Color to be determined.
      b. **Type 3:** Latitude Panel; LW12S-12F. Color to be determined
   2. Characteristics.
      a. Thickness: 24 ga. minimum
      b. The angle of the web elements of the ribs shall be symmetrical.
      c. Panel orientation: Horizontal.
      d. Configuration: Panel shall be 12” wide (nominal) with interlocking seams incorporating concealed anchor clips allowing thermal movement.
      h. Anchor clips: Clips shall be 18 gauge galvanized steel designed to allow thermal movement of the panel in each direction along the longitudinal dimension.
      j. Panel length: Up to 21 feet maximum length.

7. **ACCESSORIES**

A. Wall Panel Accessories: Provide components approved by panel manufacturer and as required for a complete metal wall panel assembly including trim, corner units, closures, clips, flashings, sealants, gaskets, fillers, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

1. **Anchor Clips:** Clips shall be 18 gauge stainless steel designed to allow thermal movement of the panel in each direction along the longitudinal dimension.

2. Spline Strip at Vertical Reveal: At the vertical reveal joint sheet metal spline material shall be provided in the same material type and finish as the metal cladding panels for all visible space at the reveal joint. Spine strip material thickness shall be as recommended by manufacturer based on installation tolerances.

3. **Corner Units:** Provide factory fabricated mitered corner units of the same profile(s) as specified. Corner units shall be furnished for outside and inside corner conditions.

4. **Ventilation strips** shall be provided at top of wall panels, window sills, and transitions between metal panels and other exterior finish materials to allow for air exhaust at top of wall cavity. Vent strips shall be internally baffled to prevent wind driven rain from freely entering the wall cavity.

5. **Ventilation strips** shall be provided at base of wall panels, window head, and transitions between metal panels and other exterior finish materials to allow for air intake and water weep holes at bottom of wall cavity.

B. Flashing and Trim: Formed from .040” aluminum, finish as wall panels. Provide flashing and trim as required to provide finished appearance. Locations include, but are not limited to, head, sill, corners, jambs, framed openings, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.
8. FABRICATION

A. Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Form flashing components from full single width sheet in minimum 10'-0" (3 m) sections. Provide mitered trim corners, joined using closed end pop rivets and butyl-based, solvent released one-part sealant.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the 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. Sealed Joints: Form nonexpanding but movable joints in metal to accommodate butyl-based sealant to comply with SMACNA standards.
   3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   4. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

9. FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Prevent unpainted metals from contact with oils or solvents, including fingerprints, which may cause staining of the natural finishes.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast. Note that some variation is anticipated and acceptable when natural (unpainted) material finishes are specified.

3. PREPERATION & EXECUTION

1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

B. Examine primary and secondary wall framing to verify that girts, studs, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal wall panel manufacturer.
C. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

D. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

2. PREPARATION
   A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

   B. Establish straight, side and crosswise benchmarks

   C. All walls shall be checked for square and straightness. Inside and outside corners may not be plumb; set a true line for the corner flashing with string line.

   D. Measure the wall lengthwise to confirm panel lengths and verify clearances for thermal movement.

3. AIR BARRIER INSTALLATION
   A. Follow manufacturer’s installation instructions.

   B. Air barrier shall be installed at all exterior wall locations. Coordinate with mason contractor for Section 04 20 00 for sequencing with masonry wall construction.

   C. Perform testing as specified herein.

4. INSULATION INSTALLATION
   A. Follow installation requirements to meet rain screen system warranty.

   B. Install insulation specified herein at all exterior locations. Coordinate with mason contractor for Section 04 20 00 for sequencing with masonry wall construction.

5. METAL SUBFRAMING INSTALLATION
   A. Install metal sub-framing directly over continuous thermal insulation. Metal sub-framing shall attach to the structural wall elements with screw fasteners. Metal sub-framing shall be spaced as necessary to accommodate the required clip spacing for the metal cladding panels.

   B. Attachments shall be as recommended by the metal claddings system manufacturer’s approved shop drawings.

6. METAL WALL PANEL INSTALLATION
   A. All details will be shown on in accordance with approved shop drawings and manufacturer’s product data, within specified erection tolerances.

   B. Directly over the completed wall substrate, fasten the top flange of the panel to the metal sub-framing using panel clips. All panels clips will be fastened into the metal sub-framing as indicated on the metal cladding panel manufacturer’s approved shop drawings.
C. Installation of Wall Panels: Wall panels can be installed by starting from one end and working towards the opposite end (vertical orientation), or from the bottom of wall working towards the top of the wall (horizontal orientation).

D. Metal wall panels and trim must be installed only in accordance with the manufacturer’s recommendation for acceptable temperature range.

E. Isolate dissimilar metals and masonry or concrete from metals with bituminous coating. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate, and panels.

F. Limit exposed fasteners to extent indicated on contract drawings.

G. Seal laps and joints in accordance with metal cladding panel system manufacturer’s product data.

H. Coordinate flashing and sheet metal work to provide weathertight conditions at wall terminations. Fabricate and install in accordance with standards of SMACNA Manual.

I. Provide for temperature expansion/contraction movement of panels at wall penetrations and wall mounted equipment in accordance with system manufacturer’s product data and design calculations.

J. Installed system shall be true to line and plane and free of dents, and physical defects. In light gauge panels with wide flat surfaces, some oil canning may be present. Oil canning does not affect the finish or structural integrity of the panel and is therefore not cause for rejection.

K. At joints in linear sheet metal items, other than metal cladding panels which are intended to provide ventilation, set sheet metal items in two ¼-inch- (6-mm-) beads of butyl sealant. Extend sealant over all metal surfaces. Mate components for positive seal. Allow no sealant to migrate onto exposed surfaces.

L. Remove damaged work and replace with new, undamaged components.

M. Touch up exposed fasteners using paint furnished by the panel manufacturer and matching exposed panel surface finish.

N. Clean exposed surfaces of wall panels and accessories after completion of installation. Leave in clean condition at date of substantial completion. Touch up minor abrasions and scratches in finish.

7. ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) at location lines as indicated and within 1/16-inch (1.5-mm) offset of adjoining faces and of alignment of matching profiles.

8. FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal wall panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal wall panels where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
9. CLEANING
   
   A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

   B. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

   END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Plastic siding and trim.

1.02 RELATED REQUIREMENTS
   A. Section 07 62 00 - Sheet Metal Flashing and Trim: Soffit panels.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. 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.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Store products in manufacturer's unopened packaging until ready for installation.
   B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in
      accordance with requirements of local authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Plastic Siding:
      5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS
   A. General Requirements:
   B. Horizontal Plastic Siding:
      1. Profile: Clapboard, Double 4-Inch; 4 inches wide; 8 inch exposure.
      2. Thickness: 0.042 inch, minimum.
      3. Length: 12 feet, minimum.
      4. Nailing Hem: Single layer, with 1-1/8 inch long nail holes at maximum 18 inch on center.
      5. Finish: Smooth.

2.03 ACCESSORIES
   A. Accessories: Provide coordinating accessories made of same material as required for complete and
      proper installation even when not specifically indicated on drawings.
      2. Length:
         a. Corner Posts: 10 feet, minimum.
         b. Other Trim: 12-1/2 feet, minimum.
      3. Starter Strip: Single-row nailing hem with elongated nailing holes 1-1/4 inch long at 18 inch on
         center, with 1/4 inch base projection.
      5. Corner Posts:
         b. Outside Corner Width: 2-7/8 inch.
B. Fasteners: Aluminum nails, alloy 5056 or 6110, with minimum tensile strength of 63,000 pounds per square inch; length as required to penetrate framing at least 3/4 inch.

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine substrate conditions before beginning installation; verify dimensions and acceptability of substrate.
B. Do not proceed with installation until unacceptable conditions have been corrected.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION
A. Install siding and trim in accordance with manufacturer’s printed installation instructions and VSI (INST).
B. Attach securely to framing, not sheathing, with horizontal components true to level and vertical components true to plumb, providing a weather resistant installation.
C. Clean dirt from surface of installed products, using mild soap and water.

END OF SECTION
SECTION 07 55 00
2-PLY - MODIFIED BUILT-UP ROOFING

PART 1 – GENERAL

1. RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. Related work specified elsewhere:
      1. Section 07 22 00 – Roof Deck Insulation.

2. SCOPE OF WORK
   A. Modified bituminous Built-Up-Roof System including but not limited to:
      1. Insulation.
      2. MODIFIED BUR MEMBRANE, 120 mil SBS (Styrene Butadiene-Styrene) rubber modified roofing membrane reinforced with a dual fiberglass scrim and polyester mat.
      3. MODIFIED BUR MEMBRANE, 80 mil SBS (Styrene Butadiene-Styrene) rubber modified roofing membrane reinforced with a dual fiberglass scrim and polyester mat. Modified membrane shall include post-consumer and post-industrial recycled materials in its manufacture.
      4. Base flashing shall incorporate 155-mil SEBS (Styrene-Ethylene-Butylene-Styrene)/ SBS (Styrene-Butadiene-Styrene), hot mop rubber modified, recycled slag mineral surfaced flashing membrane. Modified membrane shall include post-consumer and post-industrial recycled materials in its manufacture.
      5. Type III roofing asphalt, Surface coated with asphalt and #8 White washed roofing gravel.
      6. Sheathing, vapor barrier and other associated materials, (Only where indicated.)
   B. Provide all labor, equipment, and materials to install the roof system over the properly prepared substrate.

3. RELATED SECTIONS
   A. Drawings and general provisions of the Contract, including General Supplementary Conditions and Division 1 Specification Sections apply to this section.
   B. Related work specified elsewhere:
      1. Section 06 10 00 - “Roof-related Rough Carpentry” for wood blocking and nails.
      2. Section 07 62 00 - “Sheet Metal Flashing and Trim.

4. SUBMITTALS
   A. Submit under provisions of Section 01300-Submittals.
   B. Submit certification that the roof system furnished is approved by Factory Mutual, Underwriters Laboratories, or Warnock Hersey for external fire E-108 Class 1A and that the roof system is adhered properly to meet or exceed 1-60.
   C. Submit certification that the roof system furnished meets local or nationally recognized building codes for Class A Fire Rating.
   D. Provide a product data sheet for each type of product specified including manufacturer’s technical product data, installation instructions and recommendations for each type of roofing product required. Include data substantiating that materials comply with specified requirements.
   E. For all modified bituminous sheet roofing, include independent test data according to ASTM designation D-5147-91 “Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material”, substantiating that materials comply with specified requirements.
F. Submit certification that the products and materials are manufactured in the United States and that materials provided conform to all requirements specified herein, and are chemically and physically compatible with each other and are suitable for inclusion within the total roof system specified herein.

G. Submit certification that the Installer is authorized by the roofing system manufacturer as qualified to install manufacturer's roofing materials.

H. Unexecuted Manufacturer's warranty.

5. QUALITY ASSURANCE

A. Installer Qualifications: Installer (Roofer) shall be specializing in modified bituminous roof application with minimum 5 years experience and who is certified by the roofing system manufacturer as qualified to install manufacturer's roofing materials.

B. It is the intent of this specification to provide a roof system with an external fire rating. The descriptions given below are general descriptions. The insulation, recovery board, and other components shall be required by the membrane manufacturer to provide a Class A fire resistance rating.

C. Installer’s Field Supervision: Require Installer to maintain a full-time Supervisor / Foreman on job site during all phases of bituminous sheet roofing work and at any time roofing work is in progress, proper supervision of workmen shall be maintained. A copy of the specification shall be in the possession of the Supervisor/Foremen and on the roof at all times. The same foreman shall remain on the job from start to final completion.

D. It shall be the Contractor's responsibility to respond immediately to correction of roof leakage during construction. If the contractor does not respond within 24 hours, the Owner has the right to hire a qualified contractor and back charge the original contractor.

E. Disqualification of Bidders: A bidder can be disqualified by the Architect or Owner for any of the following reasons, but not limited to:
   1. Lack of proficiency as shown by past work or incomplete work under other contracts which, in the judgment of the /Architect/Owner might hinder or prevent the prompt completion of additional work if so awarded or any involvement in any legal actions which relate to past or present performance. This includes, but is not limited to lawsuits, court appointed actions, and/or ongoing litigation.

F. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

G. Pre-installation Roofing Conference: Meet at project site with Construction Manager, Architect, Owner, installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing which precedes or follows roofing work (including mechanical work if any), roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner’s insurers, test agencies and governing authorities. Objectives to include:
   1. Review methods and procedures related to roofing work, including manufacturer’s written instructions.
   2. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by other trades.
   3. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
   4. Review roofing system requirements (drawings, specifications and other contract documents).
   5. Review required submittals both completed and yet to be completed.
   6. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer’s personnel, equipment and facilities needed to make progress and avoid delays.
   7. Review required inspection, testing, certifying and material usage accounting procedures.
   8. Review governing regulations and requirements for insurance and certificates if applicable.
   9. Review procedures for coping with unfavorable weather conditions.
   10. Review temporary protection requirements for roofing before, during, after installation.
   11. Review notification procedures for weather related non-working days.
   12. Review tie-ins and patching of existing roof.
13. Review roof observation and repair procedures after roofing installation.
14. Record discussion of conference including decisions and agreements (or disagreements) reached. Furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

6. DELIVERY, STORAGE AND HANDLING
   A. Deliver products to site with seals and labels intact, in manufacturer’s original containers, dry and undamaged.
   B. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to ensure no possibility of significant moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surface. Stand all roll materials on end. Cover roll goods with a canvas tarpaulin or other breathable material (not polyethylene).
   C. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.
   D. It is the responsibility of the contractor to secure all material and equipment on the job site. If any material or equipment is stored on the roof, the contractor must make sure that the integrity of the deck is not compromised at any time. Damage to the deck caused by the contractor will be the sole responsibility of the contractor and will be repaired or replaced at his expense.

7. MANUFACTURER’S INSPECTIONS
   A. When the project is in progress, the Roofing System Manufacturer will provide the following:
      1. Keep the General Contractor, Architect and Owner informed as to the progress and quality of the work as observed.
      2. Provide job site inspections a minimum of 3 days per week. Submit a weekly progress report to the Owner’s Representative.
      3. Report to the Architect in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor’s attention.
      4. Confirm after completion of the project and based on manufacturer’s observation and tests that manufacturer has observed no applications procedures in conflict with the specifications other than those that may have been previously reported and corrected.

8. PROJECT CONDITIONS
   A. Weather Condition Limitations: Do not apply roofing membrane during inclement weather or when a 30% chance of precipitation is expected.
   B. Do not apply roofing insulation or membrane to damp deck surface.
   C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.
   D. Proceed with roofing work only when existing and forecasted weather conditions will permit unit of work to be installed in accordance with manufacturer’s recommendations and warranty requirements.
E. All slopes of greater than 1-1/2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral shank one (1) inch cap nails, or screws and plates at a rate of one (1) fastener per ply (including the modified membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and four (4) ft o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 1 ½:12, install all plies parallel to the slope (strapping) to facilitate back-nailing. Install four (4) additional fasteners at the upper edge of the modified bitumen sheet when strapping the plies.

9. SEQUENCING AND SCHEDULING
A. Sequence installation of modified bituminous sheet roofing with related units of work specified in other sections to ensure that roof assemblies including roof accessories, flashing, trim and joint sealers are protected against damage from effects of weather, corrosion and adjacent construction activity.

B. All work must be fully completed on each day. Phased construction will not be accepted unless methods are pre-approved by the membrane manufacture.

10. WARRANTY
A. Upon completion of installation, and acceptance by the Owner and Architect, the manufacturer will supply to the Owner a Thirty Year (30) Year NDL Full System Warranty (materials and labor) complete with two (2) bi-annual inspections at no cost to the owner.

B. Contractor will submit a minimum of a five-year warranty to the membrane manufacturer with a copy directly to Owner. Warranty shall include roof membrane, insulation, flashings, sheathing, wood blocking and nailers, unit skylights and all other miscellaneous items related to the roof system.

PART 2 - PRODUCTS
1. GENERAL
A. When a particular trade name or performance standard is specified it shall be indicative of a standard required.

B. Provide products as manufactured by The Garland Company, Inc.

C. Bidders proposing substitutes shall submit all required information to the Architect at least 7 business days prior to bid due date.

1. Product data indicating compliance with all project requirements.

2. A certificate from an accredited testing laboratory comparing the physical and performance attributes of all proposed materials with those of the specified materials. This certificate must not be more than six (6) months from the date of testing.

3. A list of at least five (5) projects where the proposed alternate material was used under similar conditions. Submit Architect and Owner contact information for each project. Each job must be at least five (5) years old.

4. Unexecuted roofing manufacturer’s warranty (including certification that the manufacturer will assume the warranty of all existing roofs being patched or tied into.

D. Any item or materials submitted as an alternate to the manufacturer specified must comply in all respects as to the quality and performance of the brand name specified. The Architect shall be the sole judge as to whether or not an item submitted as an equal is accepted.

2. DESCRIPTION
A. Modified bituminous roofing work including but not limited to:

1. **Vapor Barrier: Only where required:**
   a. ¼” “Dens-deck sheathing.
   b. 6 mil poly vapor barrier
   c. Two-plies of approved HPR glass fiber roofing felt bonded to the prepared substrate with hot bitumen.
2. The hot bitumen will consist of ASTM D-312 Type III steep asphalt.
   a. Softening Point 185°F - 205°F.
   b. Flash Point 500°F.
   c. Penetration @ 77°F 15-35 units.
   d. Ductility @ 77°F 2.5 cm.

3. Slopes at 1 ½": 12" shall receive Hot Bitumen: ASTM D312, Type IV special steep asphalt having the following characteristics:
   a. Softening Point 210°F - 225°F.
   b. Flash Point 500°F.
   c. Penetration @ 77°F 15-25 units.
   d. Ductility @ 77°F 1.5 cm.

3. BITUMINOUS MATERIALS
   B. Asphalt Roofing Mastic: V.O.C. compliant, ASTM D-2822, Type II.
   C. Interply adhesive.
      1. Shall meet ASTM Specifications D-312 Type III.

4. HOT APPLIED 2-PLY MODIFIED ROOF ASSEMBLY
   A. Base Ply Sheet: One (1) Ply - 120 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet reinforced with a dual fiberglass reinforced scrim, performance requirements according to ASTM D 5147
   B. Modified Cap Sheet: One (1) Ply - 80 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing membrane with dual fiberglass reinforced scrim and superior low temperature capabilities. ASTM D 6163, Type III Grade S
   C. InterPly Adhesive: Type III Asphalt: Hot Bitumen, ASTM D 312, Type III steep asphalt having the following characteristics:
      a. Softening Point 185 degrees F - 205 degrees F
      b. Flash Point 500 degrees F
      c. Penetration @ 77 degrees F 15-35 units
      d. Ductility @ 77 degrees F 2.5 cm
   D. Flashing Base Ply: One (1) Ply - 40 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet with dual fiberglass reinforced scrim. Performance requirements according to ASTM D 5147
   E. Flashing Cap (Ply) Sheet: One (1) Ply -155 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) rubber modified membrane incorporating post-consumer recycled rubber, fire retardant additives and reinforced with a fiberglass and polyester composite scrim. Surfaced with the highly reflective Sunburst white mineral. ASTM D 6162, Type III Grade G
   F. Flashing Ply Adhesive: Type III Asphalt: Hot Bitumen, ASTM D 312, Type III steep asphalt having the following characteristics:
      a. Softening Point 185 degrees F - 205 degrees F
      b. Flash Point 500 degrees F
      c. Penetration @ 77 degrees F 15-35 units
      d. Ductility @ 77 degrees F 2.5 cm

5. SURFACINGS
   A. Aggregate: To conform to #7 - #8 Roofing Gravel.
6. RELATED MATERIALS

A. Sheathing:
   1. Provide protective barrier board with "class A" fire rating over deck surfaces which shall consist of Georgia-Pacific Corp. 1/4 inch minimum "Dens-Deck".

B. Vapor Retarder
   1. Polyethylene Film: ASTM D 4397, 6 mils thick, minimum, with maximum permeance rating of 0.13 perm.
      a. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
      b. Adhesive: Manufacturer's standard lap adhesive, FM Approvals approved for vapor-retarder application.

C. Roof Insulation: Refer to Section 07 22 00.
   1. Install POLYISOCYANURATE ROOF INSULATION per roofing manufactures minimum requirements. Refer to drawings for thickness. Provide tapered units where indicated.

D. Base Sheet: shall meet the requirements of ASTM D-4601 Type II and be recommended and furnished by the membrane manufacturer.

E. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel. Fasteners shall be self-clinching type of penetrating type as recommended by the manufacturer of the deck material. Nails and fasteners shall be flush-driven through flat metal discs of not less than 1-inch diameter. Metal discs may be omitted when one-piece composite nails or fasteners with heads not less than 1-inch diameter are used.

F. Metal Discs: Flat discs or caps of zinc-coated sheet metal not lighter than 28 gauge and not less than 1-inch in diameter. Discs shall be formed to prevent dishing. Bell or cup shaped caps are not acceptable.

G. Walkway Pads: As recommended and furnished by the membrane manufacturer.

7. FINAL INSPECTION

A. At completion of roofing installation and associated work, meet with Installer, installer of associated work, Architect, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each parting attending.

C. The Roofing System Manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed.

D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.

E. Repair or replace (as required) deteriorated or defective work found at time above inspection to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. The Contractor is to notify the Architect upon completion of corrections.

G. Following the final inspection, acceptance will be made in writing by the material manufacturer.

PART 3 - GENERAL

1. EXAMINATION

A. Examine substrate surfaces to receive modified bitumen sheet roofing system and associated work and conditions under which roofing will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Roof System Manufacturer.
2. GENERAL INSTALLATION REQUIREMENTS

A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with installing the roof system.

B. Insurance/Code Compliance: Where required, install and test the roofing system to comply with governing regulation and specified insurance requirements.

C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of the modified bituminous roofing system work.

D. Coordinate installing roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight. Provide cut-offs at end of each day’s work to cover exposed ply sheets and insulation with two (2) plies of #15 organic roofing felt set in full moppings of bitumen and with joints and edges sealed with roofing cement. Remove cut-offs immediately before resuming work.

E. Asphalt Bitumen Heating: Heat and apply bitumen according to EVT Method as recommended by NRCA. Do not raise temperature above minimum normal fluid-holding temperature necessary to attain EVT (plus 5°F at point of application) more than 1 hour prior to time of application. Determine flash point, finished blowing temperature, EVT, and fire-safe handling temperature of bitumen either by information from manufacturer or by suitable test. Do not exceed recommended temperature limits during bitumen heating. Do not heat to a temperature higher than 25° below flash point. Discard bitumen that has been held at temperature exceeding finishing blowing temperature (FBT) for more than 3 hours. Keep kettle lid closed except when adding bitumen.

F. Bitumen Mopping Weights: For interply mopping, apply bitumen at the rate of approximately 25 lb. of bitumen per roof square. For a flood coat, apply bitumen at the rate of approximately 60-70 lb. of bitumen per square (plus or minus 25 percent on a total job average basis).

G. Substrate Joint Penetrations: Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

H. Apply roofing materials as specified herein unless recommended otherwise by manufacturer’s instructions. Keep roofing materials dry before and during application. Do not permit phased construction. Complete application of roofing plies, modified sheet and flashing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day.

I. Install roofing per the contract document roof system detail drawings. Minor variations to the contract document details to accommodate the manufacturer’s standard details for roof system must be submitted to the Architect for approval with the Shop Drawing submittal.

J. Tie-In Areas: Existing roof perimeters receiving new perimeter details shall have the existing built-up-roof surface prepared as follows:
1. Contractor shall spud back the existing flood coat/gravel surface a minimum of 24” onto the existing built-up-roof membrane.
2. Insulation fill shall be installed to match existing heights after new perimeter wood blocking, cant edges, etc. are installed.
3. Existing roofing felts shall be primed with cut back primer in preparation to receive new roofing felts “feathered” together onto the existing built-up-membrane shingle fashion per the manufacturer’s specifications.

K. Install sound absorbing insulation provided by Section 05310 - If Applicable to Construction

3. VAPOR-RETARDER INSTALLATION - ONLY WHERE REQUIRED

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches and 6 inches, respectively.
1. Continuously seal side and end laps with tape or adhesive.
4. BASE-PLY INSTALLATION
   A. Base Ply: Install (1) one Modified Base Ply in 25 - 30 lb. per sq. of bitumen shingled uniformly to achieve two plies throughout over the prepared substrate. Shingle in proper direction to shed water on each large area of roofing.
   B. Lap ply sheet ends eight inches. Stagger end laps twelve inches minimum.
   C. Extend plies two inches beyond top edges of cants at wall and projection bases.
   D. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies unless otherwise approved by the membrane manufacture.

5. HPR MODIFIED MEMBRANE APPLICATION
   A. The modified membrane shall then by solidly bonded to the base layers with specified asphalt at the rate of 25 to 30 lbs. per 100 square feet.
   B. The roll must push a puddle of asphalt in front of it with asphalt slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.
   C. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.
   D. Subsequent rolls of modified shall be installed across the roof as above with a minimum of 4" side laps and 8" end laps. The end laps shall be staggered. The modified membrane shall be laid in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
   E. Apply asphalt no more than five feet ahead of each roll being embedded.
   F. Extend membrane 2" beyond top edge of all cants in full moppings of the specified asphalt as shown on the drawings.

6. FLASHING MEMBRANE INSTALLATION (GENERAL)
   A. All curb, wall and parapet flashings shall be sealed with an application of mastic and mesh on a daily basis. No condition should exist that will permit moisture entering behind, around or under the roof or flashing membrane.
   B. Prepare all walls, penetrations and expansion joints to be flashed and where shown on the drawings with asphalt primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
   C. The modified membrane will be used as the flashing membrane and will be adhered to an underlying base flashing ply with specified asphalt unless otherwise noted in these specifications and nailed off 8" O.C. at all vertical surfaces.
   D. The entire sheet of flashing membrane must be solidly adhered to the substrate.
   E. Seal all vertical laps of flashing membrane with a three-course application of Flashing Bond and fiberglass mesh.
   F. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work.
   G. Roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices to be coordinated with the roofing system work are in other sections.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
   B. Soffit panels at interior location.

1.02 RELATED REQUIREMENTS
   A. Section 04 20 00 - Unit Masonry: Metal flashings embedded in masonry.
   B. Section 07 42 16 - Metal Wall Panel/Rain Screen Assembly: Flashings required for metal panel systems.
   C. Section 07 55 00 - 2 Ply Modified Built-up Roofing.
   D. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.
   E. Section 08 62 00 - Unit Skylights: Any required counterflashing.

1.03 REFERENCE STANDARDS
   B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
   B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS
   A. Pre-Finished 24 gage Galvanized Steel: ASTM A 653/A 653M, with G90/Z275 zinc coating; minimum 0.028 inch thick base metal, shop pre-coated with PVDF coating.
      1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
      2. Color: As selected by Architect from manufacturer's full line of colors.
   B. Soffit Material-Interior Roof: Aluminum, 0.024 inch thick, perforated for ventilation with channels/receivers for installation.

2.02 FABRICATION
   A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
   B. Form pieces in longest possible lengths.
   C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
   D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
   E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
   F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
G. Cap Flashings/Copings: 24 gage with continuous hook strip one gage heavier.
   1. Formed in 10 foot sections. Cover top of wall and extend down each side as detailed-minimum cover, blocking plus 1 inch. Cross joints made with 3/16 inch expansion joint, 4 inch wide cover plate, set in sealant bead. Secure in place with continuous cleats set in continuous sealant and nailed to wood blocking at 6" on center. Coping corners shall be miter seamed and sealed.

H. Overflow Scuppers: 24 gage formed to perimeter of scupper openings. Flash/form per SMACNA standards. Coordinate tie-in to roof system.

2.03 DOWNSPOUT FABRICATION
A. Downspouts: rectangular open face profile at locations indicated on drawings.
B. Accessories: Profiled to suit downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Downspout Supports: Brackets.
C. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
D. Seal metal joints.

2.04 ACCESSORIES
A. Fasteners: Galvanized steel, with soft neoprene washers.
B. Primer: Zinc chromate type.
C. Concealed Sealants: Non-curing butyl sealant.
D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify construction for acceptable conditions.

3.02 INSTALLATION
A. Install soffit panels in accordance with manufacturers instructions.
B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
C. Apply recommended sealant/adhesive compound between metal flashings and felt flashings.
D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
E. Seal metal joints watertight.

END OF SECTION
SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-sag gunnable joint sealants.
B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements: Testing information.
B. Section 04 20 00 - Unit Masonry: Instruction for exterior finish mockup and final sealant color selection.
C. Section 06 41 00 - Architectural Wood Casework: Application of sealants at countertops/wall intersection.
D. Section 07 62 00 - Sheet Metal Flashing and Trim: Sealant for flashings.
E. Section 07 84 00 - Firestopping: Firestopping sealants.
F. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.
G. Section 08 80 00 - Glazing: Glazing sealants and accessories.
H. Section 09 21 16 - Gypsum Board Assemblies: Sealant for acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

G. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Sample product warranty.
   9. Certification by manufacturer indicating that product complies with specification requirements.
   10. Instructions for repairing and replacing failed sealant joints.
C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
1.05 QUALITY ASSURANCE
   A. Maintain one copy of each referenced document covering installation requirements on site.
   B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
   D. Sample Color Verification: At locations identified by A/E, install selected color of sealant at interior and exterior building locations agreed upon with Architect and Owner for final approval.

1.06 WARRANTY
   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   B. Correct defective work within a two year period after the Date of Substantial Completion.
   C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
     18. Substitutions: See Section 01 60 00 - Product Requirements.

   B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
     14. Substitutions: See Section 01 60 00 - Product Requirements.
2.02 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
   a. Wall expansion and control joints.
   b. Joints between door, window, and other frames and adjacent construction.
   c. Joints between different exposed materials.
   d. Raked mortar joints between face brick and dissimilar materials (i.e. cmu products, cast stone, limestone).
   e. Other joints indicated below.
2. Interior Joints: Interior joints to be sealed include, but are not limited to, the following items.
   a. Joints between door, window, and other frames and adjacent construction.
   b. Intersection of countertop/backsplash at wall.
   c. Other joints indicated below.
3. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   d. Joints where installation of sealant is specified in another section.
   e. Joints between suspended panel ceilings/grid and walls.
   f. Weepholes in window frames.

B. Type JS-2 - Exterior Joints: Use non-sag silyl-terminated polyether/polyurethane sealant, unless otherwise indicated.

C. Type JS-3 - Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

A. Type JS-2 - Silyl-Terminated Polyether (STPE) and Polyurethane (STPU) Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Hardness Range: 20 to 40, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer's full range.
      a. For exterior masonry colors A/E shall select up to 3 colors from manufacturer's chart of a minimum of 30 colors. Refer to 04 20 00 for required mockup directions.
   4. Service Temperature Range: Minus 40 to 180 degrees F.
   5. Manufacturers:
      a. Sika: SikaHyflex-150 LM
      b. BASF; MasterSeal NP 150 Tint Base
      c. Tremco: Dymonic FC
      f. Substitutions: See Section 01 60 00 - Product Requirements.

B. Type JS-3 - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multicomponent; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 35 percent, minimum.
   3. Color: To be selected by Architect from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F.

5. Manufacturers:
   f. Sika Corporation; Sikaflex-2c NS: www.usa-sika.com/#sle.
   h. Substitutions: See Section 01 60 00 - Product Requirements.

C. Type JS-5 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging, paintable; not intended for exterior use.
   1. Color: To be selected by Architect from manufacturer's full range.
   2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
   3. Manufacturers:
      h. Substitutions: See Section 01 60 00 - Product Requirements.

D. Type JS-6 - Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Open Cell: 40 to 50 percent larger in diameter than joint width.
   4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.
3.02 PREPARATION
   A. Remove loose materials and foreign matter that could impair adhesion of sealant.
   B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
   C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
   D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION
   A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
   B. Perform installation in accordance with ASTM C1193.
   C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
   D. Install bond breaker backing tape where backer rod cannot be used.
   E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
   F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
   G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION
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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Application of bituminous coating on hollow metal frames installed in masonry and grout filled.
B. Section 07 92 00 - Joint Sealants: Sealing joints between door frames and adjacent construction.
C. Section 08 71 00 - Door Hardware.
D. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
E. Section 09 91 23 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
K. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
B. Supplier: A company experienced in the builders' hardware industry representing hollow metal products for a minimum of two (3) years, and can call upon an AHC, registered Architectural Hardware Consultant, for consultation during the full extent of the project.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Hollow Metal Doors and Frames:
   7. Amweld: www.amweld.com
   8. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS
A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Door Edge Profile: Manufacturers standard for application indicated.
   5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
   6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
      a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
   B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS
A. Door Finish: Factory primed and field finished.
B. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 2 - Seamless.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
   2. Core Material: polystyrene.

C. Fire-Rated Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 2 - Seamless.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
      a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      b. Attach fire rating label to each fire rated unit.
   3. Core Material: Polystyrene or mineral board. Honeycomb not allowed.

2.04 HOLLOW METAL FRAMES
   A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
   B. Frame Finish: Factory primed and field finished.
   C. Interior Door Frames, Non-Fire Rated: Face welded type.
      1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   D. Door Frames, Fire-Rated: Face welded type.
      1. Fire Rating: Same as door, labeled.
      2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
   F. Mullions for Pairs of Doors: Removable type, with profile similar to jambs.
   G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
   H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
   I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES
   A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
   B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating, applied at installation by Division 4 contractor.

2.06 ACCESSORIES
   A. Glazing: As specified in Section 08 80 00, factory installed.
   B. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
   C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
   D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify that opening sizes and tolerances are acceptable.
C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION
A. Bituminous coating at inside of frames installed in masonry or to be grouted, shall be applied by Division 4 Contractor.

3.03 INSTALLATION
A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
B. Coordinate frame anchor placement with wall construction.
C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
D. Install door hardware as specified in Section 08 71 00.
E. Comply with glazing installation requirements of Section 08 80 00.

3.04 TOLERANCES
A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING
A. Adjust for smooth and balanced door movement.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Flush wood doors; flush configuration; non-rated.
B. Sliding barn door.

1.02 RELATED REQUIREMENTS
A. Section 06 41 00 - Architectural Wood Casework: Slat wall installed on sliding door.
B. Section 08 11 13 - Hollow Metal Doors and Frames.
C. Section 08 71 00 - Door Hardware.
D. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS
A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
D. Samples: Submit two samples of door construction, 12 by 12 inch in size cut from top corner of door.
E. Samples: Submit two samples of door veneer, 12 by 12 inch in size illustrating wood grain, stain color, and sheen.
F. Manufacturer's Installation Instructions: Indicate special installation instructions.
G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE
A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
C. Supplier: A company experienced in the builders' hardware industry representing wood door products for a minimum of two (2) years, and can call upon an AHC, registered Architectural Hardware Consultant, for consultation during the full extent of the project.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Package, deliver and store doors in accordance with specified quality standard.
B. Accept doors on site in manufacturer's packaging. Inspect for damage.
C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 PROJECT CONDITIONS
A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.08 WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
PART 2 PRODUCTS

2.01 MANUFACTURERS
  A. Wood Veneer Faced Doors:
     2. Graham Wood Doors: www.architectural.masonite.com
     6. VT Industries; www.vtindustries.com
     7. Streko; www.strekodoors.com
     8. Substitutions: See Section 01 60 00 - Product Requirements.
  B. Sliding Barn Door
     1. Flush solid wood door with track hardware as specified in 08 71 00.

2.02 DOORS
  A. Doors: Refer to drawings for locations and additional requirements.
     1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
     2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
  B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
     1. Provide solid core doors at each location.

2.03 DOOR AND PANEL CORES
  A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS
  A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
  B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION
  A. Fabricate doors in accordance with door quality standard specified.
  B. Cores Constructed with stiles and rails:
  C. Provide solid blocks at lock edge for hardware reinforcement.
  D. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
  E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
  F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
  G. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS
  A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
     1. Transparent:
        a. System - 11, Polyurethane, Catalyzed.
        b. Stain: As selected by Architect.
        c. Sheen: Satin.
  B. Factory finish doors in accordance with approved sample. Stain colors shall be selected from manufacturer's full line.
  C. Seal edges as required by manufacturer's standards to meet lifetime warranty.
2.07 ACCESSORIES
   A. Hollow Metal Door Frames: As specified in Section 08 11 13.
   B. Glazing: As specified in Section 08 80 00.
   C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
   D. Door Hardware: As specified in Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify that opening sizes and tolerances are acceptable.
   C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION
   A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
   C. Use machine tools to cut or drill for hardware.
   D. Coordinate installation of new doors with installation of frames and hardware.
   E. Coordinate installation of glazing.
   F. Seal all job site sawn surfaces with two coats of polyurethane.

3.03 TOLERANCES
   A. Comply with specified quality standard for fit and clearance tolerances.
   B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING
   A. Adjust doors for smooth and balanced door movement.
   B. Adjust closers for full closure.

3.05 SCHEDULE - SEE DRAWINGS

END OF SECTION
SECTION 08 16 13
FIBERGLASS DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Fiberglass doors.

1.02 RELATED REQUIREMENTS
   A. Section 07 92 00 - Joint Sealants: Sealing joints between door frames and adjacent construction.
   B. Section 08 44 13 – Aluminum Framed Storefront: System at all aluminum frames and doors.
   C. Section 08 71 00 - Door Hardware.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide manufacturer's standard details, installation instructions, hardware and anchor recommendations.
   C. Shop Drawings: Indicate layout and profiles; include assembly methods.
      1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
      2. Indicate wall conditions, door and frame elevations, sections, materials, gages, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on drawings to identify details and openings.
   D. Selection Samples: Submit two complete sets of color chips, illustrating manufacturer's available finishes, colors, and textures.
   E. Manufacturer's Qualification Statement.
   F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
   B. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
      1. Store at temperature and humidity conditions recommended by manufacturer.
      2. Do not use non-vented plastic or canvas shelters.
      3. Immediately remove wet wrappers.
   C. Store in position recommended by manufacturer, elevated minimum 4 inch above grade, with minimum 1/4 inch space between doors.

1.07 WARRANTY
   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   B. Provide ten (10) year manufacturer warranty covering materials and workmanship, including degradation or failure due to chemical contact.
PART 2 PRODUCTS

2.01 MANUFACTURERS

- Fiberglass Reinforced Polyester Doors:
  1. Special-Lite.
  2. Commercial Door Systems; F200

2.02 FIBERGLASS REINFORCED POLYESTER FLUSH DOORS WITH ALUMINUM STILES AND RAILS

- Door Thickness: 1-3/4 inches.
- Stiles and Rails: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, minimum of 2-5/16-inch depth.
- Corners: Mitered.
- Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom integral to standard tubular shaped stiles and rails reinforced to accept hardware as specified.
- Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
- Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
- Rail caps or other face sheet capture methods are not acceptable.
- Extrude top and bottom rail legs for interlocking continuous weather bar.
- Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.
- Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded interlocking edge of bottom rail.
- Glue: Use of glue to bond sheet to core or extrusions is not acceptable.
- Face Sheet:
  1. Material: FRP, 0.120-inch thickness, finish color throughout.
  2. Protective coating: Abuse-resistant engineered surface.
  4. Color: As selected from manufacturer’s standard line.
  5. Adhesion: The use of glue to bond face sheet to foam core is prohibited.
- Core:
  2. Density: Minimum of 5 pounds per cubic foot.
- Hardware:
  1. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
  2. Factory install hardware.
- Aluminum Members:
  1. Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes: ASTM B221.
  2. Sheet and Plate: ASTM B209.
  3. Alloy and Temper: As required by manufacturer for strength, corrosion resistance, application of required finish, and control of color.
- Components: Door and frame components from same manufacturer.
- Fasteners:
  1. Material: Aluminum, 18-8 stainless steel, or other noncorrosive metal.
  2. Compatibility: Compatible with items to be fastened.
  3. Exposed Fasteners: Screws with finish matching items to be fastened.
R. Tubular Framing:
1. Size and Type: As indicated on the Drawings.
2. Materials: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, 1/8-inch minimum wall thickness.
3. Applied Door Stops: 0.625-inch high, with screws and weatherstripping. Door stop shall incorporate pressure gasketing for weathering seal. Counterpunch fastener holes in door stop to preserve full metal thickness under fastener head.
4. Frame Members: Box type with 4 enclosed sides. Open-back framing is not acceptable.
5. Sealant: Seal joints before assembling frame members.
6. Joints:
   a. Secure joints with fasteners.
   b. Provide hairline butt joint appearance.
7. Field Fabrication: Field fabrication of framing using stick material is not acceptable.
9. Hardware:
   a. Pre-machine and reinforce frame members for hardware in accordance with manufacturer's standards and hardware schedule.
   b. Factory install hardware.
10. Anchors:
    a. Anchors appropriate for wall conditions to anchor framing to wall materials.
    b. Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
    c. Secure head and sill members of transom, side lites, and similar conditions.

S. Fabrication
1. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.
2. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.
3. Assembly:
   a. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
   b. Remove burrs from cut edges.
4. Welding: Welding of doors or frames is not acceptable.
5. Fit:
   a. Maintain continuity of line and accurate relation of planes and angles.
   b. Secure attachments and support at mechanical joints with hairline fit at contacting members.
6. Class A Flame Spread and Smoke Developed Rating:
   a. Class A flame spread and smoke developed rating on interior faces of exterior panels and both faces of interior panels.
   c. Smoke Developed, ASTM E84: Maximum of 450.
7. Hardware
   a. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
   b. Factory install hardware.
8. Aluminum Finishes
   a. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.03 ACCESSORIES
A. Stops for Glazing: Fiberglass, unless otherwise indicated or required by fire rating; provided by door manufacturer to fit factory made openings, with color and texture to match door; fasteners shall maintain waterproof integrity.
2. Opening Sizes and Shapes: As indicated on drawings.
B. Glazing: As specified in Section 08 80 00.
C. Door Hardware: As specified in Section 08 71 00.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.
   B. Do not begin installation until substrates have been properly prepared.

3.02 PREPARATION
   A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   B. Clean and prepare substrate in accordance with manufacturer’s directions.
   C. Protect adjacent work and finish surfaces from damage during installation.

3.03 INSTALLATION
   A. Install in accordance with manufacturer’s instructions; do not penetrate frames with anchors.
   B. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.
   C. In masonry walls, install frames prior to laying masonry; anchor frames into masonry mortar joints; fill jambs with grout as walls are laid up.
   D. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.
   E. Repair or replace damaged installed products.

3.04 ADJUSTING
   A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.
   B. Adjust hardware for smooth and quiet operation.
   C. Adjust doors to fit snugly and close without sticking or binding.

3.05 CLEANING
   A. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.

END OF SECTION
SECTION 08 33 13
COILING COUNTER DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Non-fire-rated coiling counter doors and operating hardware.

1.02 RELATED REQUIREMENTS
A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
B. Section 09 21 16 - Gypsum Board Assemblies: Rough openings.

1.03 REFERENCE STANDARDS
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.
C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
D. Manufacturer's Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
E. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

PART 2 PRODUCTS

2.01 COILING COUNTER DOORS
A. Coiling Counter Doors, Non-Fire-Rated: Galvanized steel slat curtain.
   1. Mounting: Interior face mounted.
   3. Slat Profile: Flat.
   4. Finish, Galvanized Steel: No additional finish.
   5. Guides: Formed track; same material and finish unless otherwise indicated.
   6. Hood Enclosure: Manufacturer's standard; primed steel.

2.02 MATERIALS
A. Curtain Construction: Interlocking, single thickness slats.
   1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
   3. Steel Slats: ASTM A653/A653M galvanized steel sheet, with minimum G90/Z275 coating; minimum thickness 16 gage, 0.06 inch.
B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
   1. Guides for Galvanized Curtains: ASTM A36/A36M steel angles, size as indicated, hot-dip galvanized per ASTM A 123/A 123M.
C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
D. Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.
E. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.

F. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION
   A. Install units in accordance with manufacturer's instructions.
   B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
   C. Securely and rigidly brace components suspended from structure.
   D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.03 TOLERANCES
   A. Maintain dimensional tolerances and alignment with adjacent work.
   B. Maximum Variation From Plumb: 1/16 inch.
   C. Maximum Variation From Level: 1/16 inch.
   D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING
   A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING
   A. Clean installed components.
   B. Remove labels and visible markings.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Overhead sectional doors, manually operated.
B. Operating hardware and supports.

1.02 RELATED REQUIREMENTS
A. Section 05 50 00 - Metal Fabrications: Steel bent plate opening frame.

1.03 REFERENCE STANDARDS
A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
C. Product Data: Show component construction, anchorage method, and hardware. When glass is installed include unit u-value, center of glass u-value, visual light transmittance and solar heat gain coefficient.
D. Samples: Submit two panel finish samples, 12 by 12 inch in size, illustrating color and finish.
E. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.
F. Operation Data: Include normal operation, troubleshooting, and adjusting.
G. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.
H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 WARRANTY
A. See Section 01 78 00 - Closeout Submittals for warranty requirements.
B. Correct defective Work within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Sectional Doors:
   3. Overhead Door Co.
   5. Raynor Garage Doors.
   6. Pugleasa.
   7. C.H.I. Overhead Door.
   8. Substitutions: See Section 01 60 00 - Product Requirements.
2.02 STEEL DOORS
A. Steel Doors: Stile and rail steel with glazed panels; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
   1. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
   2. Door Nominal Thickness: 2 inches thick.
   3. Glazed Lights: Full panel width, all rows; set in place with resilient glazing channel.
B. Door Panels: Flush steel construction; outer steel sheet of 0.016 inch (28 ga) thick, flat profile; inner steel sheet of 0.014 inch (27 ga) thick, flat profile; core reinforcement of 0.060 inch thick sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; insulated.
C. Glazing: Manufacturer's standard Fully tempered glass; insulated glass units; clear; 5/8 inch overall thickness.

2.03 COMPONENTS
A. Track: Rolled galvanized steel, 0.060 inch minimum thickness; 2 inch wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch thick.
B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
F. Head Weatherstripping: EPDM rubber seal, one piece full length.
G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

2.04 MATERIALS
A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.
B. Insulated Float Glass: Provide float glass glazing, unless noted otherwise.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

3.02 PREPARATION
A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

3.03 INSTALLATION
A. Install door unit assembly in accordance with manufacturer's instructions.
B. Anchor assembly to wall construction and building framing without distortion or stress.
C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
D. Fit and align door assembly including hardware.

3.04 ADJUSTING
A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.05 CLEANING
A. Clean doors and frames.
B. Remove temporary labels and visible markings.
3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.
B. Clean doors, frames.
C. Remove temporary labels and visible markings.
D. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION
SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Aluminum-framed storefront, with vision glass. Product from this section and Section 08 44 13 shall be single sourced
B. Aluminum doors and frames.
C. Weatherstripping.

1.02 RELATED REQUIREMENTS
A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
B. Section 08 44 13 - Glazed Aluminum Curtain Walls.
C. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
D. Section 08 80 00 - Glazing: Glass and glazing accessories.
E. Division 26: Connection to related powered and access control accessories.

1.03 REFERENCE STANDARDS
A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details and unit u-value, center of glass u-value and solar heat gain coefficient.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
E. Design Data: Provide framing member structural and physical characteristics, dimensional limitations.
F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
   B. Unit U-value factors shall be labeled in accordance with NFRC 100 and 500.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Handle products of this section in accordance with AAMA CW-10.
   B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS
   A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY
   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   B. Correct defective Work within a two year period after the Date of Substantial Completion.
   C. Provide ten 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 ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Aluminum-Framed Storefront and Doors: High Performance Thermal Break for Exterior Window Framing.
      4. YKK AP: YES 60 XT (2" x 6"). www.ykkap.com
      6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ALUMINUM-FRAMED STOREFRONT
   A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
      1. Glazing Position: Centered (front to back).
      2. Exterior Vertical Mullion Dimensions: 2 inches wide x 6 inches deep
      3. Interior Vertical Mullion Dimensions: 2 inches by 4 1/2 inches, non-thermal.
      4. Frame Member Wall Thicknes: 1/8 inch.
      5. Finish: Class II color anodized.
         a. Factory finish all surfaces that will be exposed in completed assemblies.
         b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
      6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
      8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
      9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
12. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.

B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Design Wind Loads: Comply with requirements of ASCE 7.
   b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 12 psf.
3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
5. Overall System U-value Including Glazing: 0.36, maximum, measured in accordance with NFRC 100.

2.03 DOOR COMPONENTS
A. Aluminum Exterior Door Framing Members: 1/8 inch minimum wall thickness, tubular aluminum sections, drainage holes and internal weep drainage system.
B. Interior Aluminum Door Framing Members: Tubular aluminum sections, non-thermally broken.
   1. Glazing stops: Applied
C. Glazing: As specified in Section 08 80 00.

2.04 WINDOW AND SIDELIGHT COMPONENTS
A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
B. Glazing: As specified in Section 08 80 00.
C. Swing Doors: Glazed aluminum.
   2. Wide Stile: 5 inch minimum stiles and top rail.
   3. Bottom Rail: 10 inches wide minimum single rail design.
   5. Finish: Same as storefront.

2.05 MATERIALS
B. Fasteners: Stainless steel.
C. Extruded Sills: Aluminum to match window frame. Profile as detailed.
D. Perimeter Sealant: Type specified in Section 07 92 00.
E. Glass: As specified in Section 08 80 00.
F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.06 FINISHES
A. Class II Color Anodized Finish: AAMA 611 AA-M12C22A32 Integrally colored anodic coating not less than 0.4 mils thick.
B. Color: Champagne.
2.07 HARDWARE
   A. Other Door Hardware: As specified in Section 08 71 00.
   B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
   C. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all doors.

2.08 FABRICATION
   A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
   B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
   C. Prepare components to receive anchor devices. Fabricate anchors.
   D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   E. Arrange fasteners and attachments to conceal from view.
   F. Reinforce components internally for door hardware and door operators.
   G. Reinforce framing members for imposed loads.
   H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
      1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION
3.01 INSTALLATION
   A. Install wall system in accordance with manufacturer's instructions.
   B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   C. Provide alignment attachments and shims to permanently fasten system to building structure.
   D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
   E. Provide thermal isolation where components penetrate or disrupt building insulation.
   F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
   G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
   H. Coordinate installation of conduit box at head of frame and flexible conduit in frame to electric strike at electrified doors identified in Hardware Schedule with Division 26.
   I. Coordinate attachment and seal of perimeter air and vapor barrier materials.
   J. Pack fibrous insulation or apply expanding foam in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
   K. Set thresholds in bed of sealant and secure.
   L. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
   M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.02 ADJUSTING
   A. Adjust operating hardware and sash for smooth operation.

3.03 CLEANING
   A. Remove protective material from pre-finished aluminum surfaces.
   B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Aluminum-framed curtain wall, with vision glazing and glass infill panels. Note that product from this section and Section 08 43 13 shall be single sourced.

1.02 RELATED REQUIREMENTS
   A. Section 05 50 00 - Metal Fabrications: Steel attachment devices.
   B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
   C. Section 08 43 13 - Aluminum-Framed Storefronts: Entrance framing and doors.
   D. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS
   A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, unit u-value, center of glass u-value, visual light transmittance and solar heat gain coefficient, and infill.
   C. Combine submittals of this Section with Sections listed below to ensure the “design intent” of the system/assembly is understood and can be reviewed together.
      1. Section 07 92 00: Sealants related to curtain wall systems (including perimeter sealant).
      2. Section 08 43 13: Storefront framing to comply with single source requirement and aluminum doors to be installed in curtainwall framing.
      3. Section 08 71 00: Hardware.
      4. Section 08 80 00: For glass occurring within curtain wall systems.
D. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required. Large scale details of vertical and horizontal stacking joints. Large scale details for conditions at adjacent and dissimilar construction, including jamb terminations, sill sections, parapets, soffits, head sections, anchor type, size and location at jambs and/or head/sill. Profiles, thickness, and construction of members, custom extrusion, panel systems within curtainwall. Detail rain screen and weepage system. Indicate glass types, sizes, and edge clearances.

E. Design Analysis (for “Record Only”): Submit letter indicating that a registered engineer performed detailed calculations to determine component sizes, strengths, temper, deflection, and differential movement within system and between curtainwall and adjacent construction, including the following.
   1. Structural analysis of loads and reactions on system.
   2. Differential movement and deflection of system.
   3. Glazing analysis for structural and thermal resistance (glass thickness and temper).
   4. Submit letter confirming design analysis has been completed and design is in conformance thereto.
      a. Registered Professional Engineer shall sign and seal letter.
      b. Attach back-up information and separate letters confirming sealant applications and glass type and strength have been reviewed by the respective manufacturers and are appropriate for this project.
   5. Do not submit actual design calculations.

F. Samples: Submit two samples 12 by 12 inches in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.

G. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

H. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.

I. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a two 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.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Kawneer; 1600 UT.

B. Other Acceptable - Glazed Aluminum Curtain Walls Manufacturers:
   2. Oldcastle Building Envelope: www.oldcastlebe.com/
   3. Tubelite, Inc: www.tubeliteinc.com/
   5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Class II color anodized.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   2. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   5. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
   6. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
   7. Polyurethane thermal barriers shall be tested as per AAMA TIR A8-90 and AAMA Draft #13 of AAMA’s Dry Shrinkage & Composite Performance Thermal Cycling Procedure for validation testing at differential temperatures. At the conclusion of the tests, the shrinkage shall be equal to or less than the prescribed 0.10%. Use of poured and de-bridged polyurethane thermal beak assemblies will require window manufacturer’s prior adoption and continued use of the procedures and quality control features outlined in AAMA’s Quality Assurance processing guide For Poured And De-bridged Polyurethane Thermal Barriers.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the requirements of ASCE 7.
      a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
      b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
   2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.
C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 15 psf.

D. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

E. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with NFRC 500.
   2. Overall System U-value Including Glazing: 0.31 Btu/(hr sq ft deg F), maximum, measured in accordance with NFRC 100.

F. Solar Heat Gain Coefficient: As calculated by NFRC 200

2.03 COMPONENTS
A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
B. Glazing: As specified in Section 08 80 00.
C. Doors: See Section 08 43 13.

2.04 MATERIALS
B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
C. Provide sub-frame at door openings.
D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
E. Extruded Sills: Aluminum to match window frame. Profile as detailed.
F. Perimeter Sealant: Type as specified in Section 07 92 00.
G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
H. Glazing Accessories: As specified in Section 08 80 00.
I. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.05 FINISHES
A. Class II Color Anodized Finish: AAMA 611 AA-M12C22A32 Integrally colored anodic coating not less than 0.4 mils thick.
B. Color: Champagne.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify dimensions, tolerances, and method of attachment with other related work.
B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION
A. Install wall system in accordance with manufacturer's instructions and in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 and NFRC.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation or apply foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 FIELD QUALITY CONTROL

A. Testing installed windows for compliance with performance requirements for water penetration, in accordance with AAMA 501.2 using uniform pressure Test Method B.
   1. Testing optional as requested by owner performed by independent agency.
      a. Tests performed when owner determines a questionable installation has occurred.
      b. If test fails, contractor shall pay for testing.
      c. If test passes, owner shall pay for testing.

B. See Section 01 40 00 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

C. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.04 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

3.05 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Skylights with integral frame.

1.02 RELATED REQUIREMENTS
   A. Section 07 62 00 - Sheet Metal Flashing and Trim: Skylight counterflashing.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide structural, thermal, and daylighting performance values. Include unit u-value, center of glass u-value, visual light transmittance and solar heat gain coefficient.
   C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.
   D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
      1. Evidence of AAMA Certification.
      2. Evidence of WDMA Certification.
      3. Evidence of CSA Certification.
      4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
   E. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years documented experience.

1.06 WARRANTY
   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   B. Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
      1. Structural failures.
      2. Failure of systems to meet performance requirements.
      3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      4. Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of skylights from sources other than condensation, resulting from defects in skylight materials or workmanship. (Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage). Water leakage resulting from improper installations not part of this warranty
   C. Provide five year manufacturer warranty, including coverage for leakage due to defective skylight materials or construction.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Unit Skylights:
   6. Plasteco: www.plasteco.com
   7. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SKYLIGHTS

A. Skylights: Factory-assembled glazing in aluminum frame, free of visual distortion, and weathertight.
   1. Shape: Square dome.
   2. Glazing: Double or triple as required to meet performance requirements.
   3. Operation: None; fixed.
   4. Nominal Size: As indicated on drawings.

2.03 PERFORMANCE REQUIREMENTS

A. Provide unit skylights that comply with the following:
   1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific skylight type:
      a. Performance Grade (PG): Equivalent to or greater than specified design pressure.
   2. Design Pressure (DP): In accordance with ASCE 7.
   3. Allow for expansion and contraction within system components caused by a cycling surface temperature range of 170 degrees F without causing detrimental effects to system or components.

2.04 COMPONENTS

A. Glazing composition as required to meet stated u-value performance.
B. Minimum Double Glazing: Polycarbonate plastic; factory sealed.
   2. Inner Glazing: Clear transparent.
C. Frames: ASTM B221 (ASTM B221M) Extruded aluminum thermally broken, reinforced and welded corner joints, integral curb frame mounting flange and counterflashing to receive roofing flashing system, with integral condensation collection gutter, glazing retainer; mill finish.

2.05 ACCESSORIES

A. Anchorage Devices: Type recommended by manufacturer, exposed to view.
B. Counterflashings: Same metal type and finish as skylight frame.
C. Protective Back Coating: Zinc molybdate alkyd.
D. Sealant: Elastomeric, silicone or polyurethane, compatible with material being sealed.

2.06 FABRICATION

A. Fabricate free of visual distortion and defects.
B. Fabricate to achieve leakproof, weathertight assembly.
C. Fabricate components to allow for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Skylight openings are abandoned HVAC curbs. Verify that openings and substrate conditions are ready to receive work of this section.

3.02 PREPARATION

A. Make any required adjustments to curbs as required by skylight supplier.
B. Coordinate work with project roofer to tie EPDM roof as required.
3.03 INSTALLATION
   A. Install skylight units and mount securely to curb assembly; install counterflushing as required.
   B. Apply sealant to achieve watertight assembly.

3.04 CLEANING
   A. Remove protective material from prefinished aluminum surfaces.
   B. Wash down exposed surfaces; wipe surfaces clean.
   C. Remove excess sealant.

END OF SECTION
PART 1: GENERAL

1.01 RELATED DOCUMENTS
   A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED
   A. Furnish all finish hardware specified herein, listed in the hardware schedule, or required by the drawings.
   B. Where items of hardware are not definitely or correctly specified and are required for the intended service, such omission, error, or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise, furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.03 RELATED WORK
   A. Section 08 11 13 – Hollow Metal Doors and Frames.
   B. Section 08 16 13 – Fiberglass Doors.
   C. Section 08 43 13 – Aluminum-Framed Storefronts: Aluminum entrance doors.
   D. Division 26 - Electrical.

1.04 REFERENCES
   A. A.D.A. - Americans with Disabilities Act.
   B. ANSI A117.1 - Specifications for making facilities accessible to physically handicapped people.
   C. D.H.I. - Recommended Locations for Architectural Hardware.
   D. Applicable State and Local Building Codes, including IBC2009.

1.05 SUBMITTALS
   A. Submit five (5) copies of a detailed hardware schedule, vertical format. Prepare under the supervision of an AHC, registered Architectural Hardware Consultant, and under provisions of Division One.
      1. Itemize hardware in the sequence and format established by this specification.
      2. List and describe each opening separately. Include all doors with identical hardware, except hand, in a single heading. Include door number, room designations, degree of swing, and hand.
      3. List related details. Include dimensions, door and frame material, and other considerations affecting hardware.
      4. List all hardware items to be supplied. Include manufacturer's name, quantity, product name, catalog number, size, finish, attachments, and related details where applicable.
      5. Resubmit five (5) copies of the corrected schedule when required.
   B. Keying Schedule: After receipt of approved hardware schedule submit a copy of keying schedule as a result of a keying meeting between the Owner and the hardware supplier.
C. Samples: If so directed by the Architect, submit samples of finish hardware items for approval. Properly identify each sample as to make and number, and furnish in the specified finish.

D. Templates: Furnish a copy of approved hardware schedule, along with applicable templates for factory-prepared hardware to each door and frame fabricator.

E. Electrical Hardware: Submit electrical specifications and applicable information to the electrical contractor after receipt of the approved hardware schedule.

F. Substitutions: Submit under provisions of Division One. Provide detailed information and catalog cuts indicating the comparison to the specified hardware. If requested by the Architect, provide a sample accompanied by a sample of the specified item for comparison.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Except where specified in the hardware schedule, furnish products of only one manufacturer for each type of hardware.
   2. Supplier: A company experienced in the builders' hardware industry for a minimum of two (2) years, and can call upon an AHC, registered Architectural Hardware Consultant, for consultation during the full extent of the project.

B. Regulatory Requirements:
   1. Furnish UL or Warnock Hersey listed hardware for all fire labeled and 20 minute openings in conformance with requirements for class of opening specified, whether specifically called for in this specification or not.
   2. Furnish hardware that conforms to all applicable state and local building codes, including IBC 2000 positive pressure testing requirements. Where specified hardware is not in conformance with applicable codes, such omission or error should be directed to the Architect prior to the bid date for clarification by addendum; otherwise furnish hardware as required by code.

C. Training and Inspection:
   1. Hold pre-installation meeting to coordinate training of installation personnel. Installers shall be trained by manufacturer's representative.
   2. Manufacturer’s representative shall inspect installation of hardware as part of substantial completion requirements.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle in accordance with Division One. Mark each original container with a door number that corresponds to the approved hardware schedule for the installation location.

B. Receive, inventory and store hardware in a secure and dry environment; protect against loss and damage.

C. Report any shortages to the hardware supplier no later than 48 hours after receipt of delivery to the job site.

D. Stockpile items sufficiently in advance to ensure their availability. Coordinate delivery, handling, and installation of hardware items to ensure orderly progress of total work, and minimize or eliminate losses and damage.
### PART 2: PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

<table>
<thead>
<tr>
<th>Products</th>
<th>Specified</th>
<th>Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>Stanley</td>
<td>Ives, McKinney, Hager</td>
</tr>
<tr>
<td>Flush Bolts</td>
<td>Rockwood</td>
<td>DCI, Trimco, Ives</td>
</tr>
<tr>
<td>Locks and Latches</td>
<td>Marshall Best</td>
<td>NO SUB</td>
</tr>
<tr>
<td>Push/Pull Latches</td>
<td>Rockwood</td>
<td>Trimco, Burns, Hager</td>
</tr>
<tr>
<td>Exit Devices</td>
<td>Von Duprin</td>
<td>Sargent</td>
</tr>
<tr>
<td>Door Closers</td>
<td>LCN</td>
<td>NO SUB</td>
</tr>
<tr>
<td>Protective Plates</td>
<td>Rockwood</td>
<td>Burns, Hager</td>
</tr>
<tr>
<td>Overhead Stops/holders</td>
<td>ABH</td>
<td>Dorma, Glynn Johnson</td>
</tr>
<tr>
<td>Auto Operator</td>
<td>LCN</td>
<td>No substitute</td>
</tr>
<tr>
<td>Wall Stops/Floor Stops</td>
<td>Rockwood</td>
<td>Trimco, Hager, DCI</td>
</tr>
<tr>
<td>Thresholds, Sweeps, Weatherstrip</td>
<td>Reese</td>
<td>National Guard Products, Pemko</td>
</tr>
</tbody>
</table>

#### 2.02 HINGES

**A.** Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>P.B.B.</th>
<th>Stanley</th>
<th>McKinney</th>
<th>Hager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. Wt. Plain Bearing - Steel</td>
<td>PB81</td>
<td>F179</td>
<td>T2714</td>
<td>1279</td>
</tr>
<tr>
<td>Std. Wt. Ball Bearing - Steel</td>
<td>BB81</td>
<td>FBB179</td>
<td>TA2714</td>
<td>BB1279</td>
</tr>
<tr>
<td>Std. Wt. Ball Bearing - nonferrous</td>
<td>BB21/BB51</td>
<td>FBB191</td>
<td>TB2314</td>
<td>BB1191</td>
</tr>
<tr>
<td>Hvy. Wt. Ball Bearing Steel</td>
<td>4B81</td>
<td>FBB168</td>
<td>T4B3786</td>
<td>BB1168</td>
</tr>
<tr>
<td>Hvy. Wt. Ball Bearing – nonferrous</td>
<td>4B21/4B51</td>
<td>FBB179</td>
<td>T4B3386</td>
<td>BB1199</td>
</tr>
</tbody>
</table>

**B.** Hinges supplied must be tested and comply with ANSI/BHMA standards for consistency, wear and corrosion resistance.

**C.** Quantity: Furnish hinges for each door leaf as follows, unless otherwise noted in groups:
1. Doors up to and including 90" high - 3 hinges.
2. Doors over 90" high through 120" high - 4 hinges.

**D.** Type: Furnish as follows, unless otherwise noted in groups:
1. Standard weight, plain bearing hinge for interior openings through 36" wide without a door closer.
2. Standard weight, ball bearing hinge for interior openings over 36" through 40" wide with a door closer, and for interior openings through 40" wide with a door closer.
3. Heavy weight, four ball bearing hinge for all exterior openings unless noted in groups.

**E.** Size: Furnish as follows, unless otherwise noted in groups:
1. 1 3/4" doors: 4-1/2" x 4-1/2"
2. Provide proper hinge width to clear trim and allow full 180° swing.

**F.** Hinges for all lockable doors opening outward shall have non-removable pin (NRP). All other hinges shall have non-rising pins.
2.03 FLUSH BOLTS

A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>Rockwood</th>
<th>Ives</th>
<th>Trimco</th>
<th>DCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual - Metal Door</td>
<td>555</td>
<td>FB458</td>
<td>3917</td>
<td>780F</td>
</tr>
<tr>
<td>Automatic - Metal Door</td>
<td>1842</td>
<td>FB31P</td>
<td>3810</td>
<td>842</td>
</tr>
<tr>
<td>Self Latching - Metal Door</td>
<td>1845</td>
<td>FB51P</td>
<td>3820</td>
<td>845</td>
</tr>
<tr>
<td>Dust Proof Strike</td>
<td>570</td>
<td>DP2</td>
<td>3911</td>
<td>82</td>
</tr>
</tbody>
</table>

B. Furnish a dustproof strike for all bottom bolts.

2.04 LOCKS AND LATCHES

A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>Marshall Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortise Locks</td>
<td>RE Series x Sentinel</td>
</tr>
<tr>
<td>Cylindrical Locks</td>
<td>MB1 Series x 15 Style</td>
</tr>
</tbody>
</table>

B. Furnish lock types and functions as specified in the hardware schedule, and as follows:
   2. Provide 2-3/4" x 1-1/8" “T” strike with a dust box for use in wood doors or frames.
   3. Provide 4-7/8" x 1-1/4" ANSI strike for installation in a hollow metal door or frame.
   4. Locksets to conform to ANSI A156.2, Series 4000, Grade 1 and be UL listed.

2.05 EXIT DEVICES

A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>Von Duprin</th>
<th>Sargent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide Stile Rim</td>
<td>98 RIM</td>
<td>8800</td>
</tr>
<tr>
<td>Wide Stile Surf. Vert. Rod</td>
<td>9827</td>
<td>8700</td>
</tr>
<tr>
<td>Wide Stile Conc. Vert. Rod</td>
<td>9847</td>
<td>8600</td>
</tr>
<tr>
<td>Wide Stile Mortise</td>
<td>9875</td>
<td>8900</td>
</tr>
<tr>
<td>Narrow Stile Rim</td>
<td>35 RIM</td>
<td>8500</td>
</tr>
<tr>
<td>Narrow Stile Conc. Vert. Rod</td>
<td>3547</td>
<td>8400</td>
</tr>
</tbody>
</table>

B. Furnish exit device types and functions as specified in the hardware schedule.

C. Lever handles supplied with exit devices shall match the design specified for locks and latches.

2.06 PULLS, PUSHBARS, PUSH/PULL PLATES

A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>Rockwood</th>
<th>Trimco</th>
<th>Burns</th>
</tr>
</thead>
</table>

B. Supply product as listed in groups or equal to acceptable manufacturers.
2.07 DOOR CLOSERS
A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>LCN</th>
<th>Sargent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Duty Reg. Arm</td>
<td>4041</td>
<td>281</td>
</tr>
<tr>
<td>Heavy Duty Parallel Arm</td>
<td>4041 EDA</td>
<td>281 P10</td>
</tr>
<tr>
<td>Heavy Duty Stop Arm</td>
<td>4041 CUSH</td>
<td>281 PS</td>
</tr>
<tr>
<td>Medium Duty</td>
<td>1460</td>
<td>1430</td>
</tr>
<tr>
<td>Standard Duty-No Cover</td>
<td>1070</td>
<td>1100</td>
</tr>
</tbody>
</table>

B. Furnish complete with mounting brackets, drop plates, spacers, special shoes, and thru bolts as may be required by the door and frame conditions.

2.08 LOW ENERGY AUTOMATIC OPERATORS

A. Acceptable manufacturers and respective catalog numbers:
   Refer to Groups for applicable product and accessories

B. Provide arms, mounting plates, sizes, stops, and any component that may be necessary to interface with electrified hardware that are required for complete and proper operation of the openings affected. Completed installation must meet or exceed requirements of ANSI A159.19.

C. Provide actuators as detailed in groups.

2.09 PROTECTIVE PLATES
A. Acceptable manufacturers: Rockwood, Trimco, Burns, Hager.

B. All kickplate heights shall be as listed in groups and 2" less door width single doors and 1" less for pairs.

C. Thickness shall be .050" (16 gauge).

2.10 OVERHEAD STOPS/HOLDERS
A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>A.B.H.</th>
<th>Dorma</th>
<th>Glynn Johnson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Duty Surface</td>
<td>9000</td>
<td>900</td>
<td>90</td>
</tr>
<tr>
<td>Heavy Duty Concealed</td>
<td>1000</td>
<td>910</td>
<td>100</td>
</tr>
<tr>
<td>Standard Duty Surface</td>
<td>4400</td>
<td>700</td>
<td>450</td>
</tr>
<tr>
<td>Standard Duty Concealed</td>
<td>4000</td>
<td>710</td>
<td>410</td>
</tr>
</tbody>
</table>

B. Furnish an overhead stop if a door opens against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in the hardware groups.

2.11 WALL STOPS
A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>Rockwood</th>
<th>Hager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrought Convex Wall</td>
<td>407</td>
<td>232W</td>
</tr>
<tr>
<td>Wrought Concave w/Toggle</td>
<td>409</td>
<td>237W</td>
</tr>
</tbody>
</table>
B. When "wall stop" is called for in hardware group, provide 407 or 409. When overhead stops are required, they will be specified by product number in the group.

C. Wall stops shall not be mounted to casework, cabinet work, sidelights, or equipment.

2.12 THRESHOLDS, SWEEPS, WEATHERSTRIP, DRIP CAPS, GASKET, ASTRAGALS

A. Acceptable manufacturers and respective catalog numbers:

<table>
<thead>
<tr>
<th>Description</th>
<th>Reese</th>
<th>Pemko</th>
<th>National Guard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>S205</td>
<td>171A</td>
<td>425A</td>
</tr>
<tr>
<td>Sweep</td>
<td>323</td>
<td>315N</td>
<td>200N</td>
</tr>
<tr>
<td>Sweep</td>
<td>967</td>
<td>18133CP</td>
<td>OV633</td>
</tr>
<tr>
<td>Weatherstrip</td>
<td>970</td>
<td>45100CP</td>
<td>603</td>
</tr>
<tr>
<td>Weatherstrip</td>
<td>DS78</td>
<td>315CR</td>
<td>130N</td>
</tr>
<tr>
<td>Gasket</td>
<td>797B</td>
<td>S88</td>
<td>1010</td>
</tr>
</tbody>
</table>

B. Where specified in groups, furnish the above products unless otherwise detailed.

2.13 DOOR HARDWARE FINISHES

A. Unless indicated otherwise in the groups provide finishes as follows:
   1. Hinges, exterior: US32D
   2. Hinges, interior: US26D
   3. Flush Bolts: US26D
   4. Exit Devices: US32D
   5. Locks and Latches: US26D
   6. Pulls, Pushbars, Push/Pull: US32D
   7. Door Closers: Painted Aluminum
   8. Protective Plates: US32D
   9. Overhead Stops: Painted Aluminum
   10. Wall Stops: US32D
   11. Gasket: Black
   12. Thresholds: Mill Aluminum
   13. Weatherstrip, Sweeps: Clear Anodized Aluminum

2.14 KEYING REQUIREMENTS:

A. Key System: New factory-registered master key system. MBS 7-PIN Small Format Interchangeable Core. Initiate and conduct meetings(s) with Owner representatives to determine system keyway(s), keybow marking, structure, degrees of physical security and degree of geographic exclusivity. Furnish Owner's written approval of the system.

B. Small Format Interchangeable Cores: furnish 7-pin solid brass construction.

C. Cylinders/cores: keyed at factory of lock manufacturer where permanent records are maintained. Locksets and cylinders same manufacturer.

D. Permanent keys: Use secured shipment direct from point of origination to Owner.

E. Masterkeyed System Documents: Use secured shipment direct from point of origination to Owner at completion.
PART 3: EXECUTION

3.01 EXAMINATION

A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.

3.02 INSTALLATION

A. Install each hardware item in strict compliance with the manufacturer’s printed instructions and recommendations, using only fasteners supplied by, or called for by the manufacturer.

B. Set units level, plumb and true to the line and location. Prepare and reinforce the attachment substrate as necessary for proper installation and operation.

C. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work. Drill and countersink units which are not factory prepared for anchorage fasteners.

D. If manufacturer’s instructions do not call out a mounting location, refer to the Door and Hardware Institute's publication *Recommended Locations for Architectural Hardware*.

E. Deliver to the Owner one (1) complete set of installation and adjustment instructions, as well as all tools that were furnished with the hardware.

3.03 ADJUSTMENT AND CLEANING

A. At final completion, adjust and check each operating item of hardware at each door to ensure proper operation and function of every unit. Lubricate any moving parts that do not operate freely, smoothly, and quietly using only lubricant as recommended by the manufacturer of the hardware item. Replace units that cannot be adjusted or lubricated to operate properly.

B. Instruct the Owner’s personnel in the proper adjustments of the hardware as needed.

C. Clean and restore hardware to the original finish.
3.04 HARDWARE GROUPS

HARDWARE GROUP 1
EACH PAIR OF ALUM DOORS TO HAVE:
DR.100A

2 EA CONTINUOUS HINGES BY ALUM DR/FR SUPPLIER
2 EA SVR EXIT DEVICE QEL9927NL-OP X 110MD LBR 626 VONDUPRIN
1 EA RIM EXIT DEVICE 99EO 626 VONDUPRIN
1 EA RIM CYLINDER WITH CORE MBS-ICR X MBS-IC7 626 MBS
2 EA OFFSET PULLS BF157 US32D ROCKWOOD
2 EA ELECTRIC STRIKES 6300 US32D VONDUPRIN
1 EA CLOSERS 4111 EDA 689 LCN
1 EA DROP PLATES 4110-18 689 LCN
1 EA CUSH SHOE SUPPORT 4110-30 689 LCN
1 EA SENIOR SWING OPERATOR 9542 REG 689 LCN
1 EA BOLLARD 8310-866 LCN
2 EA ACTUATORS 8310-853T LCN
1 EA WEATHER SEAL 8310-801 LCN
2 EA THRESHOLD S425A36 REESE
1 EA WEATHERSTRIP/SWEEP BY ALUM DR/FR SUPPLIER
1 EA CARD READER BY ACCESS CONTROL VENDOR

SWIPE CARD TO ACCESS AREA AFTER HOURS OR BEGINNING OF DAY. SWIPE CARD TO ACCESS AREA AFTER HOURS OR BEGINNING OF DAY. CARD READER, DPS AND POWER SUPPLY BY ACCESS CONTROL VENDOR

HARDWARE GROUP 2
EACH PAIR OF ALUM DOORS TO HAVE:
DR.100B

2 EA CONTINUOUS HINGES BY ALUM DR/FR SUPPLIER
2 EA OFFSET PULLS/PUSH BF15747 US32D ROCKWOOD
1 EA CLOSERS 4111 EDA 689 LCN
1 EA DROP PLATES 4110-18 689 LCN
1 EA CUSH SHOE SUPPORT 4110-30 689 LCN
1 EA SENIOR SWING OPERATOR 9531 STD 689 LCN
2 EA ACTUATORS 8310-853T LCN
1 EA SEALS BY ALUM DR/FR SUPPLIER IF REQ

HARDWARE GROUP 3
EACH SINGLE ALUM DOOR TO HAVE:
DR. 101A

1 EA CONTINUOUS HINGE BY ALUM DR AND FRAME SUPPLIER
1 EA RIM EXIT DEVICE REUSE FROM REMOVED SOUTHSIDE DR
1 EA NIGHT LATCH TRIM 704 ETL US26D SARGENT
1 EA RIM CYLINDER WITH CORE MBS-ICR X MBS-IC7 626 MBS
1 EA CLOSER 4111 SCUSH 689 LCN
1 EA THRESHOLD S425A36 REE
1 EA SEALS IF REQ BY ALUM DR AND FRAME SUPPLIER

19021 Western Apprenticeship Center Remodel
08 71 00 - 8 DOOR HARDWARE
HARDWARE GROUP 4
EACH PAIR OF ALUM DOORS TO HAVE:
DR.101B

2 EA CONTINUOUS HINGES BY ALUM DR/FR SUPPLIER
2 EA SVR EXIT DEVICE QEL9927NL-OP X 110MD LBR 626 VONDUPRIN
2 EA POWER TRANSFERS EPT10 SP28 VONDUPRIN
1 EA POWER SUPPLY PS904 X 2RL VONDUPRIN
2 EA RIM CYLINDER WITH CORE MBS-ICR X MBS-IC7 626 MBS
2 EA OFFSET PULLS BF157 US32D ROCKWOOD
2 EA CLOSERS 4111 SCUSH 689 LCN
2 EA DROP PLATES 4110-18 689 LCN
2 EA CUSH SHOE SUPPORT 4110-30 689 LCN
2 EA THRESHOLD S425A36 REESE
1 EA CARD READER BY ACCESS CONTROL VENDOR
SWIPE CARD TO ACCESS AREA AFTER HOURS OR BEGINNING OF DAY.

HARDWARE GROUP 5
EACH SINGLE DOOR TO HAVE:
DR. 101C

3 EA BUTTS FBB179 4.5 X 4.5 652 STANLEY
1 EA OFFICE LOCK-CYL BY WESTERN TECH COLLEGE
1 EA CLOSER 4111 SCUSH 689 LCN
1 EA KICKPLATE 10 X 2"LDW US32D ROCKWOOD
1 EA SILENCERS 608RKW GREY ROCKWOOD

HARDWARE GROUP 6
EACH SINGLE DOOR TO HAVE:
DR. 102

3 EA BUTTS FBB179 4.5 X 4.5 652 STANLEY
1 EA STORERM LOCK-CYL BY WESTERN TECH COLLEGE
1 EA ELECTRIC STRIKE 6211 US32D VONDUPRIN
1 EA CLOSER 4011 REG 689 LCN
1 EA KICKPLATE 10 X 2"LDW US32D ROCKWOOD
1 EA WALL STOP 409 US32D ROCKWOOD
1 EA SILENCERS 608RKW GREY ROCKWOOD
SWIPE CARD TO ACCESS AREA AFTER HOURS OR BEGINNING OF DAY. CARD READER, DPS AND POWER SUPPLY BY ACCESS CONTROL VENDOR

HARDWARE GROUP 7
EACH SINGLE DOOR TO HAVE:
DR. 103, 104, 105, 106, 114, 115, 116, 117, 118, 120

3 EA BUTTS FBB179 4.5 X 4.5 652 STANLEY
1 EA CYL LOCK BY WESTERN TECH COLLEGE
1 EA KICKPLATE 10 X 2"LDW US32D ROCKWOOD
1 EA WALL STOP 409 US32D ROCKWOOD
1 EA SILENCERS 608RKW GREY ROCKWOOD
HARDWARE GROUP 8
EACH SINGLE DOOR TO HAVE:

DR. 107A

3 EA BUTTS FBB179 4.5 X 4.5 652 STANLEY
1 EA CYL LOCK BY WESTERN TECH COLLEGE
1 EA CLOSER 4111 EDA 689 LCN
1 EA KICKPLATE 10 X 2"LDW US32D ROCKWOOD
1 EA WALL STOP 409 US32D ROCKWOOD
1 EA SILENCERS 608RKW GREY ROCKWOOD

HARDWARE GROUP 9
EACH PAIR OF DOORS TO HAVE:

DR. 113A, 126

6 EA BUTTS FBB168 4.5 X 4.5 652 NRP STANLEY
1 EA CYL LOCK BY WESTERN TECH COLLEGE
1 EA CLOSER 4111 SCUSH 689-ACTIVE LCN
1 EA FLUSHBOLT TOP ONLY FB458 626 IVES
1 EA KICKPLATE 10 X 1"LDW US32D ROCKWOOD
1 EA SURFACE OHS 450S 652 GLYNN JOHN
1 EA GASKET F797B25 REESE
2 EA ASTRAGAL SEALS S771D7 PEMKO

HARDWARE GROUP 10
EACH PAIR OF DOORS TO HAVE:

DR. 124

6 EA BUTTS FBB168 4.5 X 4.5 652 STANLEY
1 EA CYL LOCK BY WESTERN TECH COLLEGE
1 EA CLOSER 4011 H 689-ACTIVE LCN
1 EA FLUSHBOLT TOP ONLY FB458 626 IVES
2 EA KICKPLATE 10 X 1"LDW US32D ROCKWOOD
2 EA WALL STOPS 409 US32D ROCKWOOD
1 EA GASKET F797B25 REESE
2 EA ASTRAGAL SEALS S771D7 PEMKO

HARDWARE GROUP 11
EACH SINGLE DOOR TO HAVE:

DR. 113B

1 EA CONTINUOUS HINGES BY ALUM DR/FR SUPPLIER
1 EA EXIT DEVICE REUSE EXIT DEVICE FROM EXISTING DR
1 EA NIGHT LATCH TRIM 704 ETL US26D SARGENT
1 EA RIM CYLINDER WITH CORE MBS-ICR X MBS-IC7 626 MBS
1 EA ELECTRIC STRIKE 6300 US32D VONDUPRIN
1 EA THRESHOLD S425A36 REESE
1 EA WEATHERSTRIP/SWEEP BY ALUM DR/FR SUPPLIER

SWIPE CARD TO ACCESS AREA AFTER HOURS OR BEGINNING OF DAY. CARD READER, DPS AND POWER SUPPLY BY ACCESS CONTROL VENDOR.
### HARDWARE GROUP 12
**Each single door to have:**
**DR. 121, 122, 123**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item</th>
<th>Model/Description</th>
<th>Brand</th>
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<tbody>
<tr>
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<tr>
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<td>STORERM LOCK-CYL</td>
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<td>1</td>
<td>CLOSER</td>
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<td>SWEEP</td>
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### HARDWARE GROUP 13
**Each barn sliding door to have:**
**DR., 119A**

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<thead>
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<tr>
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<td>TRACK AND HARDWARE KIT</td>
<td>RF280C-SWTK/8-1418-2</td>
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<td>1</td>
<td>BARN SLIDER DOOR LOCK</td>
<td>9100ADAL-3 26D</td>
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<tr>
<td>1</td>
<td>BARN SLIDER STRIKE KIT</td>
<td>BSTK X 1-3/4 X GAP X 26D</td>
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<td>MOR CYLINDER WITH CORE</td>
<td>MBS-ICM X MBS-IC7 626</td>
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### HARDWARE GROUP 14
**Each pair of doors to have:**
**DR.107B**

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<td>SVR EXIT DEVICE</td>
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<td>RIM CYLINDER WITH CORE</td>
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<td>CLOSERS</td>
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<tr>
<td>2</td>
<td>WALL STOPS</td>
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<td>ROCKWOOD</td>
</tr>
<tr>
<td>1</td>
<td>GASKET</td>
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<td>REESE</td>
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<tr>
<td>2</td>
<td>ASTRAGAL FINS</td>
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<td>PEMKO</td>
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### HARDWARE GROUP 15
**Each single door to have:**
**DR. 127, 132**

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<td>DOOR POSITION SWITCH</td>
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### HARDWARE GROUP 16
**Each single door to have:**
**DR.123A**

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<th>Quantity</th>
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<th>Brand</th>
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<td>BUTTS</td>
<td>FBB179 4.5 X 4.5 652</td>
<td>STANLEY</td>
</tr>
<tr>
<td>1</td>
<td>STORERM LOCK</td>
<td>BY WESTERN TECH COLLEGE</td>
<td></td>
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<tr>
<td>1</td>
<td>CLOSER</td>
<td>4111 REG 689</td>
<td>LCN</td>
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<td>1</td>
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<tr>
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*END OF SECTION*
SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Insulating glass units.
B. Glazing units.
C. Plastic sheet glazing units.

1.02 RELATED REQUIREMENTS
A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
C. Section 08 14 16 - FLUSH WOOD DOORS: Glazed lites in doors.
D. Section 08 36 13 - Sectional Doors: Glazed lites in doors by door supplier.
E. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.
F. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.

1.03 REFERENCE STANDARDS
J. GANA (GM) - GANA Glazing Manual; 2009.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors. Coordinate the following information with product in Section 08 43 13; unit u-value, center of glass u-value and solar heat gain coefficient.
D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE
A. Perform Work in accordance with GANA (GM), GANA (SM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 FIELD CONDITIONS
A. Do not install glazing when ambient temperature is less than 40 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY
A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Float Glass Manufacturers:
   4. Oldcastle Glass: www.oldcastleglass.com
   7. Substitutions: Refer to Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES
A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.
B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.

2.03 GLASS MATERIALS
A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   3. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.
2.04 INSULATING GLASS UNITS

A. Manufacturers:
   1. Any of the manufacturers specified for float glass.
   2. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
   3. Substitutions: Refer to Section 01 60 00 - Product Requirements.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Metal Edge Spacers: Aluminum, bent and soldered corners.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
   7. Purge interpane space with dry air, hermetically sealed.

   1. Applications: Ground floor windows away from doors and as scheduled.
   2. Space between lites filled with argon.
   3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
   4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
      b. Low-E Coating, Basis of Design: PPG Solarban 60 on #2 surface.
   5. Total Thickness: 1 inch.
   6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.24, nominal.
   8. Solar Heat Gain Coefficient (SHGC):.38, nominal.

2.05 GLAZING UNITS

A. GLT-4 - Monolithic Safety Glazing: Non-fire-rated.
   1. Applications:
      a. Glazed lites in doors, except fire doors.
      b. Glazed sidelights to doors, except in fire-rated walls and partitions.
      c. Other locations required by applicable federal, state, and local codes and regulations.
      d. Other locations indicated on drawings.
   2. Glass Type: Fully tempered safety glass as specified.
   3. Tint: Clear.
   4. Thickness: 1/4 inch, nominal.

2.06 PLASTIC SHEET GLAZING UNITS

A. GLT-9 - Acrylic Sheet: Refer to Drawings for attachment accessories.
   1. Application: Locations as indicated on drawings.
   2. Type: Monolithic (single layer solid) sheet.
   3. Ultraviolet stabilized.
   4. Tint: Clear.
   5. Thickness: 1/2 inch.
   6. Manufacturers:
      c. Evonik Industries: www.acrylite.net.
      d. Substitutions: Refer to Section 01 60 00 - Product Requirements.
PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION
SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Carpet tile.
B. Removal of existing floor coverings.
C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
D. Testing of new concrete floor slabs for moisture and alkalinity (pH).
E. Patching and leveling compound.

1.02 RELATED REQUIREMENTS
A. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.
B. Section 03 30 00 - Cast-In-Place Concrete: Limitations on curing requirements for new concrete floor slabs and coordination of any other special requirements affecting concrete floor preparations.

1.03 REFERENCE STANDARDS
A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS
A. Visual Observation Report: For existing floor coverings to be removed.
B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.
C. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   5. Recommendations for remediation of unsatisfactory surfaces.
   7. Submit report not more than two business days after conclusion of testing.
D. Adhesive Bond and Compatibility Test Report.
E. Copy of RFCI (RWP).

1.06 QUALITY ASSURANCE
A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.07 FIELD CONDITIONS
A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS
2.01 MATERIALS
A. Floor Topping, Leveler and Patching Compound: Free flowing self-leveling, pumpable, cement-based compound for applications from 1-1/2 inch thick to feathered edges, minimum strength of 4000 psi.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Schonox; US. www.hpsubfloors.com
      b. Schonox; AP. www.hpsubfloors.com
      c. MAPEI Corporation; Ultraplan Easy with Primer T. www.mapei.com
      d. Maxxon Great Lakes; Level-Right Maxx. www.maxxon.com
      e. Ardex, Inc; K-15. www.ardexamericas.com

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

PART 3 EXECUTION
3.01 CONCRETE SLAB PREPARATION
A. Refer to Section 03 30 00 for responsibilities of all contractors to protect concrete floors from contamination. Start of work by flooring contractor indicate acceptance of conditions.
B. Follow recommendations of testing agency.
C. Perform following operations in the order indicated: (Moisture testing shall occur a minimum of 60 days prior to installation of flooring systems, with any required remediation efforts to begin immediately after test results.)
   1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
      a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
      b. Removal of existing floor covering.
   2. Preliminary cleaning.
   3. New Concrete: Internal relative humidity tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Specified remediation, if required.
   6. Patching, smoothing, and leveling, as required to meet manufacturer's requirements.
   7. Other preparation specified by flooring manufacturer.
3.02 REMOVAL OF EXISTING FLOOR COVERINGS
   A. Do test removal to determine how many layers of existing flooring occur.
   B. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
   C. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING
   A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
   B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
   C. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F1869. Obtain instructions if test results are not within the following limits:
      1. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours.
   D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
   E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as required. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
   F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
   C. Test in accordance with ASTM F2170 and as follows.
   D. Verify that new concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity. Obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer. Testing procedures shall be:
      1. Maximum allowable moisture levels for each type of floor finish shall be received from flooring suppliers prior to testing.
      2. At floors to receive finish materials, perform three tests for the first 1000 square feet and at least one additional test for each additional 1000 square feet.
      3. Select test locations to provide information about moisture distribution across the entire floor slab, especially areas of potential high moisture. For slabs on-grade and below-grade, include a test location within three feet of each exterior wall.
   E. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
   F. In the event that test values exceed floor covering manufacturer's limits, perform remediation as required. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
   G. Report: Report the information required by the test method.
3.06 ALKALINITY TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
      1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
      2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
      3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
   C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION
   A. See individual floor covering section(s) for additional requirements.
   B. Comply with requirements and recommendations of floor covering manufacturer.
   C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
   D. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING
   A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING
   A. Comply with requirements and recommendations of coating manufacturer.

3.10 PROTECTION
   A. Cover prepared floors with building paper or other durable covering.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Acoustic insulation.
D. Gypsum wallboard.
E. Joint treatment and accessories.
F. Acoustic sealant and installation of acoustic accessories, (sealants, insulation, etc.).

1.02 RELATED REQUIREMENTS
A. Section 05 40 00 - Cold-Formed Metal Framing: Exterior sheathing.
B. Section 07 21 19 - Expanding Foam Insulation: Insulation installed in stud cavities.
C. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
D. Section 09 91 23 - Interior Painting.
E. Section 10 26 00 - Wall and Door Protection. Wall protection panels and corner guards.

1.03 REFERENCE STANDARDS
A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
O. ASTM E413 - Classification for Rating Sound Insulation; 2016.
1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
D. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE
A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 3 years of experience.
B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS
2.01 METAL FRAMING MATERIALS
A. Manufacturers - Metal Framing, Connectors, and Accessories:
5. Telling Industries: www.buildstrong.com
B. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
1. Exception: The minimum metal thickness and section properties requirements of ASTM C645 are waived provided steel of 40 ksi minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E 72 using assemblies specified by ASTM C754.
2. Studs: "C" shaped with flat or formed webs with knurled faces.
C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
3. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
   a. Products:
      1) FireTrak Corporation; Posi Klip.
      2) Metal-Lite, Inc; The System.
      3) ClarkDietrich Building Systems; MaxTrack Slotted Deflection Track
      4) Substitutions: See Section 01 60 00 - Product Requirements.
4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.
5. Deep legged track, minimum 2 inches with crimped stud allowed.
D. Non-structural Framing Accessories:
1. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
   a. Products:
   a. Products:
      1) ClarkDietrich; Danback: www.clarkdietrich.com/#sle.

3. Sheet Metal Backer:
   a. 22 ga. 4 foot wide sheet metal installed as backer. Refer to Drawings for locations.

2.02 BOARD MATERIALS
A. Manufacturers - Gypsum-Based Board: Note: No offshore produced gypsum board allowed.
   7. Substitutions: See Section 01 60 00 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold resistant board is required wet walls of restrooms.
   3. Thickness:

4. Paper-Faced Products:
   a. American Gypsum Company; FireBloc Type X Gypsum Wallboard.
   b. American Gypsum Company; FireBloc Type C Gypsum Wallboard.
   c. CertainTeed Corporation; Type X Gypsum Board.
   d. Georgia-Pacific Gypsum; ToughRock.
   e. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
   f. USG Corporation; Sheetrock Brand Gypsum Panels.
   g. Substitutions: See Section 01 60 00 - Product Requirements.

5. Mold Resistant Paper Faced Products:
   a. American Gypsum Company; M-Bloc.
   b. American Gypsum Company; M-Bloc Type X.
   c. Continental Building Products; Mold Defense.
   d. Continental Building Products; Mold Defense Type X.
   e. CertainTeed Corporation; M2Tech ans M2Tech Type X.
   f. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
   g. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
   h. National Gypsum Company; Gold Bond XP Gypsum Board with Sporgard.
   i. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
   j. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 GYPSUM WALLBOARD ACCESSORIES
A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch or as noted on Drawings.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Composition: Permanently tacky non-hardening butyl sealant.
   2. Products:
      h. Substitutions: See Section 01 60 00 - Product Requirements.
C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. Edge Seal Bead: Use to seal around windows, doors, and where drywall butts up to different smooth wall materials. Gasket compresses upon installation to form a permanent seal and no sealant required. Do not install at acoustical wall perimeters.
      a. Trim-Tex: Super Seal Tear Away L Bead
   3. Expansion Joints:
      a. Type: Accordion profile with factory-installed protective tape.
      b. Products:
         1) Trim-Tex, Inc; Hideaway Expansion: www.trim-tex.com/#sle.
D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION
   A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
   B. Studs: Space studs at 16 inches on center.
      1. Extend partition framing to structure in all locations. Install slip track at structure as detailed on drawings.
      2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
   C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jamb s.
   D. Top of Wall: Coordinate installation of required top of sound control materials.
   E. Blocking: Install wood blocking or mechanically fastened steel sheet for support of:
      1. Framed openings.
      2. Wall mounted cabinets.
      3. Plumbing fixtures.
      4. Toilet accessories.
      5. Wall mounted door hardware.

3.03 ACOUSTIC ACCESSORIES INSTALLATION
   A. Acoustic Insulation in Non-Fire-Rated Construction: seal around all penetrations by conduit, pipe, ducts, and rough-in boxes. Tape oversized piece of 2 inch sound blanket over backside of boxes. See plans for additional instruction. Seal pipe and conduit penetrations with acoustical sealant backed with backer rod or acoustic insulation. Follow manufacturer's recommendations for control of annular space. HVAC contractor responsible for sound attenuation controls in duct work.
   B. Acoustic Sealant: Install in accordance with manufacturer's instructions. and according to directions on plan.
      1. Place one bead continuously on substrate before installation of perimeter framing members.
      2. Place continuous bead at perimeter of each layer of gypsum board.
      3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.
      4. Follow rating requirements for fire rated walls that are sound walls as well. Firestopping contractor shall install required materials at rated walls.
3.04 BOARD INSTALLATION
   A. Comply with ASTM C840, GA-216, and manufacturer’s instructions. Install to minimize butt end joints, especially in highly visible locations.
   B. Single-Layer Non-Rated: Install gypsum board perpendicular to framing, with ends and edges occurring over firm bearing.
      1. Exception: Tapered edges to receive joint treatment at right angles to framing.
   C. Installation on Metal Framing: Use screws for attachment of gypsum board.
   D. Installation on Wood Framing: For non-rated assemblies, install as follows:

3.05 INSTALLATION OF TRIM AND ACCESSORIES
   A. Control joint placement indicated is an industry recommended minimum. Follow manufacturer and industry location and detail recommendations. Review project plans and consult with A/E to confirm appropriate joint placement.
   B. Control Joints: Place control joints consistent with lines of building spaces and as follows:
      1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
      2. Install continuous from each door jamb to top of partition.
      3. At wings of "L", "U", and "T" shaped ceilings.
      4. Control joints in rated walls shall be constructed to meet tested assemblies.
      5. All control joints shall have double studs located behind them.
   C. Corner Beads: Install at external corners, using longest practical lengths.
   D. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.06 JOINT TREATMENT
   A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
      1. Level 5: Walls and ceilings to receive wall protection panels from Section 10 26 00..
      2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
      3. Level 3: Walls to receive textured wall finish.
      4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
      5. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
      6. Level 0: Temporary partitions.
   B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
      1. Feather coats of joint compound so that camber is maximum 1/32 inch.
      2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
      3. Taping, filling and sanding is not required at base layer of double layer applications.
   C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
   D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 FINISH
   A. All painted gypsum board walls shall have a smooth finish.

3.08 TOLERANCES
   A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.
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PART 1  GENERAL

1.01  SECTION INCLUDES
   A. Suspended metal grid ceiling system.
   B. Acoustical units.

1.02  RELATED REQUIREMENTS
   A. Section 09 54 23 - Linear Metal Ceilings
   B. Mechanical Supply and Return Devices Division 23
   C. Electrical Light Fixtures Division 26

1.03  REFERENCE STANDARDS
   A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04  SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on suspension system components and acoustical units.
   C. Samples: Submit two samples 12 by 12 inch in size illustrating material and finish of acoustical units.
   D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05  QUALITY ASSURANCE
   A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06  FIELD CONDITIONS
   A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2  PRODUCTS

2.01  MANUFACTURERS
   A. Acoustic Tiles/Panels:
      1. Roxul Rockfon. www.rockfon.com
   B. Steel Suspension Systems:

2.02  ACOUSTICAL UNITS
   A. Acoustical Units - General: ASTM E1264, Class A.
   B. BOARD TYPE ACT-2: 2'x2' Tegular
      1. Rockfon: Artic #660

2.03  SUSPENSION SYSTEM(S)
   A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, and perimeter moldings as required.
      1. Materials:
         a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
   B. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
      1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
      2. Profile: Tee; 15/16 inch face width.
      3. Finish: Baked enamel.
2.04 ACCESSORIES
   A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system
      flatness requirement specified.
   B. Hanger Wire: 12-gage 0.08 inch galvanized steel wire.
   C. Perimeter Moldings: Same metal and finish as grid.
      1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM
   A. Rigidly secure system, including integral mechanical and electrical components, for maximum
      deflection of 1:360.
   B. Locate system on room axis according to reflected plan.
   C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other
      interruptions.
      1. Use longest practical lengths.
      2. Miter corners.
   D. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts,
      pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of
      adjacent members.
   E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected
      hangers and related carrying channels to span the extra distance.
   F. Do not support components on main runners or cross runners if weight causes total dead load to
      exceed deflection capability.
   G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support
      components independently.
   H. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS
   A. Install acoustical units in accordance with manufacturer's instructions.
   B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and
      function.
   C. Fit border trim neatly against abutting surfaces.
   D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
   E. Cutting Acoustical Units:
      1. Cut to fit irregular grid and perimeter edge trim.
      2. Make field cut edges of same profile as factory edges.
   F. Where round obstructions occur, provide preformed closures to match perimeter molding.
   G. Provide tegular edge at walls and other abutting vertical surfaces. Field paint cut edges to surface color
      and sheen.

END OF SECTION
SECTION 09 54 23
LINEAR METAL CEILINGS

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. Linear metal ceilings.
   B. Suspended metal support system and perimeter trim.

1.02  RELATED REQUIREMENTS
   A. Section 09 51 00 - Acoustical Ceilings

1.03  REFERENCE STANDARDS

1.04  ADMINISTRATIVE REQUIREMENTS
   A. Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.
   B. Sequencing: Supply hanger clips during steel deck erection. Supply additional hangers and inserts as required.

1.05  SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Furnish for component profiles.
   C. Shop Drawings: Indicate reflected ceiling plan.
   D. Samples: Submit two samples 4 by 12 inch in size illustrating color and finish of exposed to view components.

1.06  QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
   B. Installer Qualifications: Company specializing in performing the work of this section.
      1. Minimum 3 years documented experience.

1.07  WARRANTY
   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2  PRODUCTS
2.01  MANUFACTURERS
   A. Linear Metal Ceilings: Basis of Design;
      1. Rockfon: Rockfon Curvgrid EZ-flex. www.rockfon.com

2.02  LINEAR METAL CEILINGS
   A. Board Type LMC-1: Linear Metal Ceiling Clouds: Panels, suspension members, trim and accessories as required to provide a complete system.
   B. Performance Requirements:
      1. Design to support imposed loads of indicated items without eccentric loading of supports.
      2. Design for maximum deflection of 1/360 of span.

2.03  COMPONENTS
   A. Curved Panels:
      1. Wave pattern prefinished aluminum panels with concealed grid as detailed on Drawings.
      2. Color:
      3. 2 inch high perimeter trim.
      4. Size: See Drawings.
   B. Suspension Wire: Steel, annealed, galvanized finish, 9 gage, 0.1144 inch diameter.
2.04 FABRICATION
   A. Shop fabricated with all components, ready for installation.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify that layout of hangers will not interfere with other work.
   C. Verify that required utilities are available, in proper location, and ready for use.
   D. Verify that field measurements are as indicated.

3.02 INSTALLATION
   A. Suspension Components:
      1. Install after above-ceiling work is complete in accordance with manufacturer's instructions, ASTM C636/C636M, and ASTM E580/E580M.
      2. Hang carrying members independent of walls, columns, ducts, light fixtures, pipe, and conduit; where carrying members are spliced, avoid visible displacement of face panels with adjacent panels.
      3. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest adjacent hangers to span the required distance.
   B. Curved Ceiling Panels:
      1. Install panels and other system components in accordance with manufacturer's instructions.

3.03 CLEANING
   A. Clean finished surfaces.
   B. Replace damaged or abraded components.

END OF SECTION
PART 1 GENERAL
1.01 SECTION INCLUDES
A. Resilient tile flooring.
B. Resilient base.
C. Installation accessories.

1.02 RELATED REQUIREMENTS
A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS
B. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS
A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.07 EXTRA MATERIALS
A. Deliver stock of extra materials to Owner. Furnish extra materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
   1. Furnish one box for each type, color, pattern and size installed.

PART 2 PRODUCTS
2.01 TILE FLOORING
A. Luxury Vinyl Tile: Plank type tile as indicated on Master Color Schedule on ID Drawings. Comparable products by prior approval of submitted samples showing color match and equal performance criteria.

2.02 RESILIENT BASE
A. Resilient Base: ASTM F1861, Type TV, vinyl, thermoplastic; top set Style B, Cove.
   1. Height: 4 inch.
   2. Thickness: 0.125 inch.
   4. Length: Roll.
   5. Color: Refer to master Color Schedule for basis of design.

2.03 ACCESSORIES
A. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
B. Moldings, Transition and Edge Strips: Same material as flooring.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
D. Prohibit traffic until filler is fully cured.
E. Clean substrate.
F. Apply primer as required to prevent “bleed-through” or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL
A. Starting installation constitutes acceptance of subfloor conditions.
B. Install in accordance with manufacturer’s written instructions.
C. Adhesive-Applied Installation:
   1. Spread only enough adhesive to permit installation of materials before initial set.
   2. Fit joints and butt seams tightly.
   3. Set flooring in place, press with heavy roller to attain full adhesion.
D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.
F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING
A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 INSTALLATION - RESILIENT BASE
A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
C. Install base on solid backing. Bond tightly to wall and floor surfaces. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
   1. Adhesive shall cover a minimum of 90 percent of ribbed back of base.
   2. Leave 1/4 inch uncovered at top edge of base to prevent oozing.
   3. Roll base firmly, roll back toward starting point.
D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING
A. Remove excess adhesive from floor, base, and wall surfaces without damage.
B. Clean in accordance with manufacturer’s written instructions.

3.07 PROTECTION
A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fluid-applied flooring and base.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
C. Manufacturer's Installation Instructions: Indicate special procedures.
D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.04 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Applicator Qualifications: Company specializing in performing the work of this section.
   1. Minimum 3 years of documented experience.
   2. Approved by manufacturer.
C. Supervisor Qualifications: Trained by product manufacturer, under direct full time supervision of manufacturer's own foreman.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Store resin materials in a dry, secure area.
B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.06 FIELD CONDITIONS
A. Maintain minimum temperature in storage area of 55 degrees F.
B. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Fluid-Applied Flooring:
   1. Basis of Design: Sherwin Williams/General Polymer: Decorative Mosaic Coating System with CU-11, D-size chip (1/16"). Color as selected by A/E. Add slip resistant grit. No grit at room 1221 or ITC1.
   2. Tennant Flake DB:
      1st Broadcast Coat: Eco-MPE with vinyl flake broadcast
      2nd Broadcast coat: Eco-MPE with vinyl flake broadcast
      Grout Coat: Eco-URE
      Topcoat; Eco-HTS 10
2.02 FLUID-APPLIED FLOORING SYSTEMS
   A. Fluid-Applied Flooring: Primer, epoxy base coat(s), polyurethane top coat, vinyl chips and polyurethane seal coat.
      2. Texture: Smooth and slip resistant as scheduled.

2.03 ACCESSORIES
   A. Primer: Type recommended by fluid-applied flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
   B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.
   C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.
   D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
   A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.
   B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
   C. Vacuum clean substrate.
   D. Apply primer to surfaces required by flooring manufacturer.

3.03 INSTALLATION - FLOORING
   A. Apply in accordance with manufacturer's instructions.
   B. Apply each coat to minimum thickness indicated.
   C. Finish to smooth level surface.
   D. Cove at vertical surfaces as noted on Drawings

3.04 PROTECTION
   A. Prohibit traffic on floor finish for 48 hours after installation.
   B. Barricade area to protect flooring until fully cured.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS
   A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
   B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
   C. Section 09 65 00 - Resilient Flooring: Resilient base.

1.03 REFERENCE STANDARDS
   B. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
   C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
   D. Manufacturer's Installation Instructions: Indicate special procedures.
   E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALITY ASSURANCE
   A. Installer Qualifications: Company specializing in installing carpet with minimum 3 years experience who is certified by the Floor Covering Installation Board (FCIB) or who can demonstrate compliance with FCIB certification program requirements.
   B. Single Source Responsibility: Obtain carpet tile from one source and by a single manufacturer.

1.06 WARRANTY
   A. Provide carpet manufacturer's 5 year warranty against defects in materials. Warranty coverage shall include:
      1. Surface Wear: Not more than 10 percent by weight throughout life of project.
      2. Static: Maintain static generation at less than 3.5 kV at 70 degrees F, and 20 percent R.H. throughout life of product.
      3. No delamination throughout life of product.
      4. No edge ravel throughout life of product.
      5. Provide tuft bind consistent with industry standards.
      6. No dimensional instability (i.e. shrinkage, curling and doming), which adversely affects ability of carpet tile to lie flat throughout life of product.
   B. Provide carpet installer's one (1) year warranty against defects in installation.

1.07 FIELD CONDITIONS
   A. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.08 EXTRA MATERIALS
   A. Provide one full carton of carpet tiles of each color and pattern selected.
PART 2 PRODUCTS

2.01 MATERIALS
A. Tile Carpeting: Tufted, manufactured in one color dye lot.
   1. Refer to Master Color Schedule affiliated with Interior Drawings for product selection.
   2. Surface Flammability Ignition: Pass ASTM D2859 (the “pill test”).

2.02 ACCESSORIES
A. Edge Strips: Vinyl, color as selected by Architect.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
B. If surfaces cannot be put into proper condition for carpet tile installation by customary cleaning and prepping operations, Contractor shall report defects immediately to Architect in writing. Application of carpet tile materials is considered acceptance of surfaces condition by this Contractor and any subsequent repairs and/or refinishing required shall be performed at this Contractor's expense.
C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
D. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 05 61.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION
A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

3.03 INSTALLATION
A. Starting installation constitutes acceptance of subfloor conditions.
B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
C. Blend carpet from different cartons to ensure minimal variation in color match.
D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
F. Locate change of color or pattern between rooms under door centerline.
G. Fully adhere carpet tile to substrate.
H. Trim carpet tile neatly at walls and around interruptions.
I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING
A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel overhead door jambs.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   7. Marble, granite, slate, and other natural stones.
   8. Floors, unless specifically indicated.
   10. Glass.
   11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Shop-primed items.
B. Section 09 91 23 - Interior Painting.

1.03 REFERENCE STANDARDS

A. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
B. SSPC-SP 1 - Solvent Cleaning; 2015.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.
   4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
E. Manufacturer's Instructions: Indicate special surface preparation procedures.
F. Maintenance Data: Submit data including product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
B. Paints:
   4. Benjamin Moore: www.benjaminmoore.com
C. Primer Sealers: Same manufacturer as top coats.
D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
C. Colors: As indicated in Color Schedule.
   1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
   2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR
   A. EPS 2 Galvanized Metal, Primed (overhead door jambs): Acrylic Semi-Gloss
      2. (SW) Two coats Pro Industrial Multi Surface Acrylic B66-1550 Series.
      3. (HL) One coat Metalguard DTM Acrylic Primer/finish 338 and two coats Rustoleum High Performance DTM Acrylic 3800,

2.04 ACCESSORY MATERIALS
   A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
   B. Patching Material: Latex filler.
   C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Do not begin application of paints and finishes until substrates have been properly prepared.
   B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
   C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
   D. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION
   A. Clean surfaces thoroughly and correct defects prior to application.
   B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   C. Ferrous Metal:
      1. Coordinate surface preparation in accordance with requirements of selected paint/coating supplier recommendations.
      2. Solvent clean according to SSPC-SP 1.

3.03 APPLICATION
   A. Apply products in accordance with manufacturer's written instructions.
   B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
   C. Apply each coat to uniform appearance.

3.04 CLEANING
   A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION
   A. Protect finishes until completion of project.
   B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION
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PART 1  GENERAL

1.01  SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied
      primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating
      parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
  10. Glass.
   11. Concrete masonry units in utility, mechanical, and electrical spaces.
   12. Acoustical materials, unless specifically indicated.
   13. Concealed pipes, ducts, and conduits.

1.02  RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Shop-primed items.
B. Section 08 11 13 - Hollow Metal Doors and Frames: Frames and doors to be field painted.
C. Section 09 91 13 - Exterior Painting.

1.03  DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04  REFERENCE STANDARDS

   Coatings; U.S. Environmental Protection Agency; current edition.
C. SSPC-SP 1 - Solvent Cleaning; 2015.

1.05  SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g.
      "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each
      system.
   3. Manufacturer's installation instructions.
   4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions
      proposed.
C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of
   colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to
      eliminate sheens definitely not required.
D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
E. Manufacturer's Instructions: Indicate special surface preparation procedures.
F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

**1.06 DELIVERY, STORAGE, AND HANDLING**

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

**1.07 FIELD CONDITIONS**

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
   2. Hallman-Lindsay (HL): www.hallmanlindsay.com
   4. Benjamin Moore: www.benjaminmoore.com

C. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 PAINTS AND FINISHES - GENERAL**

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
6. Paint for insulated piping shall be latex based. If the insulation taping is rippled due to oil based application, the Painter shall be responsible for replacement of the insulation. Certain Class A, non-combustible paints may maintain a 25/50 smoke rating for the painted pipe insulation, PVC jacketing and fittings. Check with state and local building codes and fire marshal for approved practice before painting.

B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: As indicated in Color Schedule.
   1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
   2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   3. Hardwood generally will be the same color stain throughout. Painted wood surfaces will be a different color and/or sheen than adjacent surfaces.
   4. In finished areas, diffusers, grilles, registers, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
   5. In unfinished areas: Paint all woodwork, doors and metal frames, convectors, ladders, railings, gratings and the like.

2.03 PAINT SYSTEMS - INTERIOR

A. IPS 7 Ferrous Metal (Primed): 100% Acrylic Latex Satin/Semi-Gloss, Non-blocking
   1. (SW) Spot prime with DTM Acrylic Primer B66W1, two coats ProClassic Waterborne Acrylic Semi-Gloss B31 Series.
   2. (SW) Two coats Pro Industrial Multi Surface Acrylic B66-1550 Series.
   3. (HL) One coat Metalguard DTM Acrylic Primer/finish 338 and two coats Duratech 100% Acrylic Satin Enamel 318

B. IPS 7A (doors) Ferrous Metal (Primed): (Hollow metal Doors and Frames) 100% Acrylic Latex Satin/Semi-Gloss, Non-blocking
   1. (SW) One coat ProCryl Universal Primer B66-310 Series, two coats B66-600 Series HP Acrylic
   2. (HL) One coat Metalguard DTM Acrylic Primer/finish 338 and two coats Rustoleum High Performance DTM Acrylic 3800.

C. IPS 10 Exposed Overhead Work: 100% Acrylic Dryfall Flat, Flash Rust Resistant
   1. (SW) Spot prime with ProCryl Universal Primer B66-1310 Series, one coat Low VOC Acrylic Dryfall B42W81 Series.
   2. (HL) Spot primer with Metalguard DTM Primer/Finish 338, one coat Fast Dry Latex Flat Dryfall 251.

D. IPS 11 Concrete Block: Vinyl Acrylic Latex Eggshell over 100% Acrylic Block Filler, certifiable to ph13, surface to be pinhole free
   1. (SW) One coat Loxon Block Surfacer LX2W50, two coats ProMar 200 0 VOC Latex Eg-shel B20W12600 Series.
   2. (HL) One coat Fill Tite Acrylic Block Filler 179, two coats Pro Kote Interior Latex Zero VOC Eggshell 284.

E. IPS 16 Gypsum Board: Vinyl Acrylic Latex Eggshell over Vinyl Acrylic Primer
   1. (SW) One coat PrepRite 200 Latex Wall Primer B28W2600, two coats ProMar 200 0 VOC Latex Eg-Shel, B20W12600 Series.
   2. (HL) One coat Pro Wall Primer Zero VOC 227, two coats Pro Kote Interior Latex Zero VOC Eggshell 284.
F. IPS 17 Gypsum Board: Pre-Catalyzed Epoxy Semi-Gloss over Acrylic Latex Primer
   1. (SW) One coat ProMar 200 0 VOC Latex Wall Primer B28W2600, two coats Pre-catalyzed Epoxy K46W1151
   2. (HL) One coat Pro Wall Primer Zero VOC 227, two coats of Aqua Precat WB Semi-Gloss Epoxy 515.

G. IPS 23 Existing Painted Concrete Block: Latex Egg Shell
   1. (SW) Two coats ProMar 200 0 VOC Latex Eg-Shel B20W1260 Series.
   2. (HL) Two coats Pro Kote Interior Latex Zero VOC Eggshell 284.

H. IPS 26 Existing Painted Gypsum Board: Vinyl Acrylic Latex Eggshell over existing paint
   1. (SW) One coat ProCryl Universal Primer B66-1310 Series, two coats ProMar 200 0 VOC Latex Eg-Shel, B20W1260 Series.
   2. (HL) One coat Stainguard 100% Acrylic Primer 526, two coats Pro Kote Interior Latex Zero VOC Eggshell 284.

I. IPS 30 Existing Painted Metal (handrails): Oil Based Airless Sprayer Applied Finish System. (follow manufacturer’s application instruction for preparation, primer and finish coats).
   1. (SW) One coat Kem 400 Primer. One coat Sher-Kem High Gloss Metal Finishing Enamel catalyzed 8 to 1 ratio with Hardner V66V1020.
   2. (Benjamin Moore) One coat recommended primer. One Coat Corotech High Performance, Electrostatic Semi-gloss Enamel V260 catalyzed with Corotech® V705-90 Gloss & Hardness Catalyst at a rate of 1 pint per gallon.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. 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. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.
H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
I. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.
J. Ferrous Metal:
   1. Coordinate surface preparation in accordance with requirements of selected paint/coating supplier recommendations.
   2. Solvent clean according to SSPC-SP 1.
   4. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer. Protect from corrosion until coated.
K. Metal Doors and/or Frames to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION
A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer’s written instructions.
C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING
A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION
A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION
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SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Corner guards.
   B. Protective wall covering.

1.02 RELATED REQUIREMENTS
   A. Section 09 21 16 - Gypsum Board Assemblies: Surface preparation.

1.03 REFERENCE STANDARDS
   A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of
      Plastics; 2010 (Reapproved 2018).

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
   C. Shop Drawings: Include plans, elevation, sections, and attachment details.
   D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
      1. Submit two sections of corner guards, 12 inches long.
      2. Submit two samples of protective wall covering and door surface protection, 6 by 6 inches square.
   E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special
      attention.
   F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed
      in Owner's name and registered with manufacturer.
   G. Maintenance Data: For each type of product. Include information regarding recommended and
      potentially detrimental cleaning materials and methods.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to
      designate installation locations.
   B. Protect work from moisture damage.
   C. Protect work from UV light damage.
   D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and
      interior temperature and humidity are in compliance with manufacturer's recommendations for each
      type of item.
   E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.06 WARRANTY
   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PRODUCT TYPES
   A. Corner/End Guards - Surface Mounted:
      1. Product: Refer to Master Color Schedule for basis of design.
      2. Length: One piece.
      3. All accessories for a complete finished system.
   B. Protective Wall Covering:
      1. Refer to Master Color Schedule for basis of design.
      2. UL classified rigid vinyl sheet conforming with the NFPA Class A fire rating
      3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and
         smoke developed index of 450 or less, when tested in accordance with ASTM E84.
4. Impact Strength of 30.4 ft-lbs/ inch of thickness as tested in accordance with the procedures specified in ASTM D256-90b, Impact Resistance of Plastics.
5. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

C. Adhesives and Primers: As recommended by manufacturer.

2.02 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
B. Verify that field measurements are as indicated on drawings.
C. Verify that substrate surfaces for adhered items are clean and smooth.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

3.03 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION
SECTION 10 51 26
PLASTIC LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Solid plastic lockers.

1.02 RELATED REQUIREMENTS
A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
D. Samples: Submit two samples 12 by 12 inches in size, of each color scheduled.
E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Solid Plastic Lockers:
   2. Scranton Products; Tufftec: www.scrantonproducts.com/#sle.

2.02 SOLID PLASTIC LOCKERS
A. Lockers: Factory assembled, made of solid plastic panels, tested in accordance with NFPA 286, homogenous color throughout.
   1. Material: Solid high density polyethylene (HDPE).
   2. Doors: Full overlay without frame.
   3. Fabricate locker components for snap-together assembly or slide-together dovetail connections providing solid and secure, anti-racking construction.
   4. Where locker ends or sides are exposed, provide same finish as fronts or provide extra panels to match fronts.
   5. Provide filler strips where indicated, securely attached to lockers.
   6. Door Color: To be selected by Architect.
   7. Body Color: Manufacturer's standard white or light color.
   8. Size: As indicated on Drawings.
B. Component Thicknesses:
   1. Doors: 1/2 inch minimum thickness.
   2. Locker Body: Tops, bottoms, backs, and shelves 3/8 inch minimum.
   3. End Panels and Filler Panels: 1/2 inch minimum thickness.
   4. Sloped Tops: 1/2 inch minimum thickness.
   5. Toe Kick Plates: 1/2 inch minimum thickness.
C. Hinges: Full height of locker, aluminum with stainless steel pin; manufacturer's standard heavy duty type.
D. Coat Hooks: High impact plastic.
E. Number Plates: Provide rectangular shaped aluminum plates. Form numbers of block font style, in contrasting color.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that prepared bases are in correct position and configuration.

3.02 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Place and secure on prepared base.
   C. Install lockers plumb and square.
   D. Install end panels and filler panels.
   E. Install fittings if not factory installed.
   F. Replace components that do not operate smoothly.

3.03 CLEANING
   A. Clean locker interiors and exterior surfaces.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS
   A. Applicable provisions of Division 1 shall govern the work of this section.

1.03 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials,
      finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
   B. Handle and store shades in accordance with manufacturer's recommendations.

1.05 WARRANTY
   A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
      1. Shade Hardware: One year.
      2. Fabric: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Interior Manually Operated Roller Shades: Refer to Master Color Schedule for basis of design.
      Comparable products from:
      1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.

2.02 ROLLER SHADES
   A. General:
      1. Provide shade system components that are easy to remove or adjust without removal of mounted
         shade brackets.
      2. Provide shade system that operates smoothly when shades are raised or lowered.
      3. Flammability: Pass NFPA 701 large and small tests.
   B. Roller Shades:
      1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system
         complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
         a. Drop Position: Regular roll.
         b. Roll Direction: Roll down, closed position is at window sill.
         c. Mounting: Window jamb mounted- inside, between jambs.
         d. Size: As indicated on drawings.
         e. Fabric: As indicated under Shade Fabric article.
      2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and
         to accommodate shade fabric roll-up size and weight.
      3. Roller Tubes: As required for type of shade operation.
      4. Hembars: Designed to maintain bottom of shade straight and flat.
      5. Manual Operation for Interior Shades:
         a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
         b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength.
         Provide upper and lower limit stops.
2.03 LIGHT FILTERING SHADE FABRIC
   A. Fabric for Light-Filtering Shades: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   B. Refer to Master Color Schedule on ID Drawings for basis of design.

2.04 ROLLER SHADE FABRICATION
   A. Field measure finished openings prior to ordering or fabrication.
   B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
      1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
      2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine finished openings for deficiencies that may preclude satisfactory installation.
   B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
   C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION
   A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
   B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION
   A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
   B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
   C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING
   A. Clean soiled shades and exposed components as recommended by manufacturer.
   B. Replace shades that cannot be cleaned to "like new" condition.

END OF SECTION
SECTION 22 00 00
TABLE OF CONTENTS FOR PLUMBING

21 05 00    Fire Protection System
22 05 00    Common Work Results for Plumbing
22 05 14    Piping Specialties for Plumbing
22 05 15    Piping Testing for Plumbing
22 05 23    General-Duty Valves for Plumbing Piping
22 05 29    Hangers and Supports for Plumbing Piping and Equipment
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22 11 13    Facility Water Distribution Piping
22 13 16    Facility Sanitary Waste and Vent Piping
22 14 13    Facility Storm Drainage Piping
22 30 00    Sump Pumps
22 42 00    Commercial Plumbing Fixtures
22 42 20    Water Heating Equipment and Accessories

END SECTION
PART 1 - GENERAL

1.1 Scope

A. Any General Provisions distributed by the Architect or Construction Manager shall apply to all Sections of Division 21.

B. Provide all materials, labor, services and incidentals necessary for the completion of this Division of the Work.

1.2 Description of Work

A. Furnish all labor, materials and equipment for a complete fire protection system acceptable to the governing authorities.

B. Perform all required operations and coordinate with other crafts.

C. Obtain and pay for all permits and fees.

D. The fire protection system for this building consists of the following:

1. A NFPA 13 wet pipe system for all occupied and un-occupied spaces that are normally maintained at room temperatures above freezing.

2. A NFPA 13 dry pipe system for all spaces that are not normally maintained at temperatures above freezing.
   a) This provision applies to the new Vestibule 100, even if the Vestibule is intended to be maintained above freezing temperatures.
   b) Alternate methods of freeze-resistance will be an acceptable alternative to a dry pipe system.

1.3 Work Included

A. All work as required by local Fire Department, State Fire Marshall and local Building Department.

B. All interior piping, sprinkler heads, appurtenances, fittings, and all other necessary items.

C. The water service is existing and the fire protection riser is assumed to be suitable for re-use, include fire department connections, alarms, valving, and drain valves.

1.4 Quality Assurance

A. Fire protection system shall be installed by a contractor normally engaged in the installation of automatic sprinkler systems.

B. In the acceptance or rejection of work performed under this Section, no allowance will be made for lack of skill on the part of the workman.
C. All equipment and work shall conform to the requirements of the local building code, NFPA and all legal authorities having jurisdiction.

D. A copy of the "Contractor's Manual and Test Certificate" as found in NFPA Standard No. 13 shall be submitted upon completion of the job.

E. Contractor shall be licensed for such work in the State of Wisconsin.

F. Contractor shall have successfully completed a minimum of (3) similar projects in Wisconsin within a 75 mile radius of the Project Site.

1.5 Contract Drawings

A. The fire protection system is not shown on the Project Drawings. The Contractor is responsible for all design and layout.

B. It is the Contractor's responsibility to facilitate installation of the system, avoid interference's, coordinate with other trades and comply with the installation requirements of NFPA 13.

C. A complete set of Project Drawings in software format will be provided upon request for use in preparing Shop Drawings. Documents are available in both Autocad and Revit format. 3D fire sprinkler shop drawings are not required for this project.

1.6 Submittals

A. Within fifteen (15) working days after award of contract, the contractor shall submit, at one time, six copies each of brochures of all manufactured items furnished, and six copies of shop drawings of the fire protection system for approval. (Electronic submittal of submittals will be acceptable, in lieu of multiple paper copies.)

1.7 Shop Drawings

A. The contractor shall prepare detailed shop drawings of the fire protection system on the contract drawings. Sufficient sections and details shall be shown to allow complete review of the system. The contractor shall coordinate with all trades in preparing the shop drawings.

B. Slopes, drains and inspector test stations are not shown. These shall be located by the contractor and shown on the shop drawings.

C. Coordinate the location of sprinklers in rooms with suspended ceilings with the approved reflected ceiling plan. Shop drawings shall show the outline of the ceiling grid, lights and diffusers.

D. Manufacturers Literature: Provide brochures of all manufactured items clearly marked indicating the size, performance, materials, installation details, etc. inapplicable items shall be marked out.
1.8 Record Documents

A. During progress of the work, keep an up-to-date set of prints showing all changes made in the fire protection system from the original shop drawings and materials shown on the approved submittals. After completion of work provide the Engineer with an electronic set of as build shop drawings submitted in PDF format.

1.9 Product Handling

A. Protection: Use all means necessary to protect the work and materials of this section before, during and after installation and to protect the work and materials of all other trades.

1.10 Guarantee

A. All labor and materials for one year after Substantial Completion certificate is prepared. All defective work shall be replaced to the full satisfaction of the Engineer, and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 Design Parameters

A. The system shall comply with NFPA 13 – Current Edition.

B. The occupied areas of this building have multiple Occupancy Classifications. Refer to the notations on the Drawings. Use the specified Occupancy Classifications for Bidding Purposes. This Contractor is charged with the responsibility of contacting the local Fire Department to determine the Hazard ratings of all areas prior to completing any final design work.

C. All distribution piping shall be installed as shown or implied on the Drawings. Sprinkler heads shall be installed recessed into the ceiling with matching escutcheons where suspended acoustical ceilings are being used.

D. Provide wire guards on all sprinkler heads in areas with exposed fire sprinkler piping if the head is orientated in the downward position, sidewall position, or is located less than 12 feet above finished floor level.

2.2 Water Supply

A. Static and residual pressure at the site shall be determined on site by the Contractor. Contact the local Municipality. (*These pressures are posted on the existing fire sprinkler riser.*)

B. Contact the Local Municipal Fire Department for current information if the posted information is greater than 3 years old.
2.3 Piping Materials

A. General: All material shall be new and of highest grade, U.L. listed and conforming to NFPA 13. The Contractor may be required, at his own expense, to remove any non-approved materials installed and provide materials as specified.

B. Pipe: In general, any of the following pipe types may be used:

1. Black steel per ASTM A53.
2. Galvanized steel per ASTM A795.
3. Wrought steel per ANSI B36.10M

C. Fittings:

1. Screwed fittings shall be cast iron conforming to ASME specifications B16.1 and B16.4. or malleable iron conforming to ASME B16.3
2. "Victaulic" type mechanical couplings may be used with cut groove standard weight pipe and roll groove thin wall pipe.
3. "Thread-O-Let" outlets may be used at the contractor's discretion for long branch lines, etc.

2.4 Piping Products

A. General: Provide factory-fabricated products of the size and type indicated. Where not indicated, provide products as determined by the installer to comply with installation requirements and to comply with NFPA 13. Provide sizes and types matching piping, fitting and equipment connections.

B. Sprinkler Heads:

1. Type:
   a. All occupied and "finished" rooms: Chrome-plated pendant type with deep escutcheons. Pendants should be set nearly flush with the ceiling finish – projecting only as required for proper operation. Escutcheons shall be white color finish.
   b. Areas without ceilings: Upright type, brass unless noted otherwise.
   d. Five (5) extra sprinkler heads of each type used, and one sprinkler wrench shall be furnished for each sprinkler system. Heads and wrench shall be stored in a cabinet mounted near each system riser.

C. Fire Department Connection: (Existing – no work required.)

D. Drip Valve: (Existing – no work required.)

E. Alarm Horn: (Existing – no work required.)

F. Flow Switches: (Existing – no work required.)
G. Supervisory Tamper Switches: (Existing – no work required.)

H. Pressure Gauges: (Existing – no work required.)

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. System piping shall comply with the requirements of NFPA and local Fire Department.
2. Sprinklers shall be coordinated with the lights and HVAC diffusers.
3. Sprinklers in exposed areas shall be installed for best coverage and maximum protection from accidental damage and actuation.
4. Re-use existing fire sprinkler mains as best possible. Existing piping, hangers, and related may be salvaged in place and re-used or modified to suit the new room use or configuration.

B. The contractor shall adequately support all aboveground piping in a manner which is considered good practice and which satisfies the requirements of all governing regulations, authorities, the Engineer and comply with NFPA Standard No. 13.

PART 4 – IDENTIFICATION

A. (The existing sprinkler riser shall be assumed to adequately identified.)

B. Label and identify any new fire sprinkler zones, valves, or related in a manner consistent with the existing labeling scheme, but in full compliance with NFPA 13.

PART 5 – TESTING

A. All sprinkler piping (underground and overhead) shall be hydrostatically tested for four hours at 200 PSI. This provision shall apply to all existing piping after revisions have been completed. The entire system shall be pressure tested.

B. Per NFPA, local Fire Department, and all legal authorities having jurisdiction. The Owner's representative shall witness all testing.

PART 6 - CLEAN-UP

A. Clean up to the satisfaction of the Engineer and Owner.

B. Any heads covered with paint and/or plaster debris shall be replaced by this Contractor at no additional cost to the Owner.

C. Remove all debris from site in a timely manner.

END SECTION
PART 1 - GENERAL

1.1 SCOPE

A. The requirements of Division 1 shall apply to all Sections of Division 22, including but not limited to the following:

1. The Owner shall be notified prior to interruption of any plumbing, heating, ventilating or air conditioning systems so same can be coordinated with their schedule.
2. For information relating to "As-Built Drawings", refer to Division 1.
3. Submit "Shop Drawings" in accord with Division 1.
4. For "Temporary Facilities and Control", refer to Division 1.
5. For information relating to "Warranties and Guarantees", refer to Division 1.

B. Provide all materials, labor, services and incidentals necessary for the completion of this Division of the Work.

C. The requirements of Section 23 05 00 apply to all Sections of Division 15.

1.2 Codes and Standards

A. Comply with the latest applicable Codes and Standards as set forth by the following:

   ANSI  American National Standards Institute
   ASME  American Society of Mechanical Engineers
   ASTM  American Society for Testing and Materials
   EPA  U.S. Environmental Protection Agency
   NEC  National Electric Code
   NFPA  National Fire Protection Association
   UL  Underwriters Laboratories

B. Water heaters, storage tanks and other pressure vessels shall be A.S.M.E. constructed and stamped, unless noted below. Boilers shall be installed as per ASME Codes, by Contractor's having ASME Certification, where required.

C. Comply with and pay fees for all required permits and inspections.

D. Where drawings and specifications call for materials or workmanship in excess of these requirements, drawings and specifications shall govern.

1.3 DELIVERY, STORAGE AND HANDLING

A. Cover and protect all materials and equipment stored at Project Site from weather. Support above ground on temporary bases.

B. Cover all mechanical products and control devices from damage, dust, plaster and other construction debris. After installation is completed or while storing inside building, wrap and enclose all fixtures, equipment and control devices with canvas or heavy mill plastic, secured with wire or cord. Fixtures may be protected with the factory applied heavy paper or carton they are shipped in. Do not remove protection device until room or area is cleaned and free of dust and debris.
PART 2 - PRODUCTS

2.1 MATERIALS, FIXTURES AND EQUIPMENT

A. Provide all new materials and equipment to complete Work, unless otherwise specified.

B. All pipe sizes are I.D. unless otherwise indicated.

2.2 PRODUCT BID APPROVAL

A. Submit Bid based on materials and equipment of manufacturers specified. Catalog numbers of base manufacturer establishes quality required. Other manufacturers listed may be bid without prior approval of Engineer, providing quality of product is equal to base specification.

1. All items specified shall be the latest type or model produced by manufacturer specified. If descriptive specification or model number is obsolete, substitute current product.

B. Whenever a product of a manufacturer other than the Base Specification is furnished, the respective Mechanical Contractor shall include in his Bid, any additional costs for labor and/or materials required to adapt the substituted equipment variations, to the original system design. This includes full compensation to other Trades for changes required in their work. Variations include, but are not limited to:

1. Additional breeching, piping extensions, stack revisions, etc. for changes in location of water heater venting and combustion air.
2. Additional piping extensions for equipment tapping variations.
3. Additional structural support for heavier equipment.
4. Changes in sizes of equipment supports and equipment pads.
5. Added cost for changes in electrical work; larger motors, wiring, disconnects, starters, lighting relocation, etc. When motors are varied from Base Specification, an additional shop drawing of equipment shall be submitted to the Electrical Contractor, with changes noted thereon.
6. Drawings shall be submitted to Engineer for approval, when variations require extensive piping, ductwork or system revisions.

2.3 GUARDS

A. All equipment having belt-driven motors, shall include belt guards.

B. All motor shafts shall have guards.

C. Guards shall be sheet steel, cast iron, expanded metal or wire mesh. Include access hole for speed measurement.

2.4 STEEL SUPPORT AND HANGERS

A. Steel angle or pipe supports for floor mounted equipment and steel hangers for suspended equipment, including supplemental beams or angles mounted to building structure, will be furnished and installed by respective Mechanical Contractor; designed to carry total supported weight.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Piping, ducts and similar items are shown on Project Drawings in approximate position desired; do not scale.

B. Determine exact location at Project Site by preliminary layout of systems (electrical, mechanical, structural, etc.) and resolve all conflicts.

C. Install exposed piping parallel to building lines, at uniform grade and at sufficient distance from walls to allow proper connections to risers and drops.

D. Close openings and open ends of all piping during construction to exclude dust, debris and vandalism.

E. Seal openings around piping and pipe sleeves penetrating walls, floors and ceilings; including areas above suspended ceilings, as follows:
   1. Required fire rated penetrations:
      a. Fire-resistant acoustic material, or
      b. Nelson's "Flameseal" fire stop putty, or
      c. 3M "Fire Barrier" Caulk #CP-25, or #CP25WB, or
      d. "Chase Foam" CTC PR-855 fire resistant silicone foam sealant, or
      e. "ProSet" piping penetration systems.
   2. Sound rated and return air zone penetration, that are not a required fire rated assembly:
      a. Fiberglass blanket insulation.

F. Exterior walls and floors on grade:
   1. Thiocaulk or equal waterproofing caulking.
   2. Penetrations such as exterior walls, attics, roofs, etc., separating heated from unheated spaces (to prevent freezing temperatures from infiltrating into pipe spaces):
      a. Rock Wool safing insulation in fire-rated areas.
      b. Fiberglass blanket insulation in non-fire-rated areas.

G. No piping shall be permitted to be installed in, enter or pass through spaces dedicated for electrical switchboards, panelboards, distribution boards, etc. Dedicated spaces extend from floor to structural ceiling with a width and depth that of the electrical equipment plus the working space in front of same with a width matching the equipment but not less than 30 inches, a depth of 36 inches and a height to at least 75 inches above floor. (Sections 110-16 and 384-4 of NFPA 70.)

3.2 OPENINGS THRU ROOF

A. All piping, and other items passing through roof shall be at least 18 inches apart and 18 inches in from roof edge, to permit proper flashing.

3.3 EXCAVATION AND BACKFILLING

A. Conform to Section 02200 "Earthwork".

B. Perform excavation required for related underground piping. Include clearing of excavated area, and provide trenching, tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation of earth, fill and backfilling.

C. Refer to the Project Drawings for subsurface soil data, contours, site conditions, and the like.
D. Excavate whatever material is encountered to depth required. Excavation shall extend one foot out from each side of pipe. Bottom of trench or excavation shall be level and compacted to assure firm foundation.

E. All excavated materials that are not useable or more than required for backfilling, shall be removed from Project Site and legally disposed of.

F. Protect excavation from caving or washing and erect necessary barricades, complying with regulations set forth in General Orders on "Safety in Construction" and "Tunneling, Caisson and Trench Construction", issued by the State Department of Industry, Labor and Human Relations or other governing authority.

G. Lay all pipe in open trenches unless A/E gives written approval for tunneling.

H. Separate trenches shall be provided for each sewer, water or gas distribution line, unless otherwise permitted in other Sections of the Specification or indicated on drawings.

I. All underground piping shall be supported on a bedding of sand or granular material at least 4 inches thick.

J. Backfill with clean sand to one foot above top of piping and thoroughly compact by hand. Backfill to rough grade in 12 inch deep horizontal layers, thoroughly compacted with earth free of cinders, stones and debris. Remove forms, shoring, etc. as backfill is placed. All backfilling under footings must be compacted within 8 feet of all footings.

K. When running a pipe below a footing and parallel to it, same shall in all cases be at least one foot greater in distance away from footing than below its bottom. Where possible, run lines at center point between two parallel footings and maintain above mentioned distances at minimum. When running under a footing, disturb as little of the soil under footing as possible. Provide concrete fill under all footings where excavations wider than 18 inches are required.

3.4 ADJUSTMENTS

A. Adjust all specialty items and controls to normal operating position.

B. Start and operate all mechanical equipment and systems prior to occupancy by Owner.

C. Lubricate all motors, bearings and similar items, prior to completion of project and before operating equipment.

D. All motor belt drives shall be checked for proper alignment and belt tension.

E. All mechanical couplings shall be checked for alignment.

F. Pressure Vessels: Pressure relief valves on storage tanks, etc., shall be checked for setting and accuracy. Raise pressure on system to cause operation of relief valves.

3.5 ACCESSIBILITY

A. Access panels to valves, controls and equipment in walls or above inaccessible ceilings, will normally be indicated on Architectural Drawings.

B. Provide access to all concealed mechanical equipment or accessories requiring same, not indicated on Architectural Drawings.
C. Size of panels shall be larger than the devices requiring access, but shall be not less than 6" square for wall panels and not less than 12" square for ceiling panels. Where the openings must allow adequate room for a person to pass through, a 24" X 24" panel shall be provided.

D. Construction of panels shall comply with the following:

1. For Masonry, Tile or Wallboard Surfaces - 16 gage steel frame with 1" wide flange, 16 gage steel panels, concealed hinges, screwdriver operated cam lock, baked enamel prime coat. Panel shall be Milcor Style M, or approved equal.
2. For Acoustical Tile Ceilings - Flangeless construction of even tile module, 16 gage steel frame, 18 gage recessed door panel for receiving acoustic tile, continuous hinge, flush screwdriver operated cam latch, white prime coat finish; Milcor Style A or approved equal. Access panels will not be required in accessible type ceilings.
3. For Plastered Ceilings or Walls - Concealed flange, recessed door panel to receive plaster by others, 16 gage galvanized steel frame, 18 gage galvanized steel panel, 3.4 gauge galvanized steel lath continuous hinges, flush latch, white prime coat finish; Milcor Type B or approved equal.
4. For Fire Rated Partition - Access doors in fire rated walls shall be 1-1/2 hour B rated and shall bear the UL label. Doors shall be fabricated of steel and shall be provided with a baked enamel prime coat over a phosphate coating. Doors shall be Milcor or approved equal.

3.6 CLEAN-UP

A. Refer to Division 1.

B. Remove all dust, plaster and construction debris from ductwork, piping, fixtures and equipment prior to painting or occupancy by Owner.

C. Touch-up paint on all mechanical equipment which has rusted or has had finish marred during construction. Replace if satisfactory repair cannot be made.

D. Pipe system cleansing, sterilizing and other cleaning is specified in appropriate Sections of this Division.

3.7 MAINTENANCE DATA AND OPERATING INSTRUCTIONS

A. Deliver to the Owner, through the Architect/Engineer maintenance and operating instructions, with replacement parts list for all fixtures and equipment.

B. Include a complete lubrication schedule for all mechanical equipment, with type of lubricant and frequency recommended.

C. Instruct and demonstrate to the Owner or his representative, the operation and servicing (normal maintenance) of all equipment and systems provided.

PART 4 - ELECTRICAL WORK

4.1 Furnish electric motors with mechanical equipment. Motors shall conform to the standard specifications of the IEE, bearing nameplate of manufacturer, with current and operating characteristics noted thereon.

A. Motors shall conform to the latest N.E.M.A. Standards.
B. Motor horsepower voltage and phase is indicated on equipment schedules or under equipment specification.

C. Motors up to 1/3 H.P., will be standard type.

D. Motors shall have service factors of not less than 1.20.

E. Mechanical equipment with motors 1/2 horsepower or larger, shall have power factors of at least 90 percent. Motors shall be Baldor Super E or equal, energy efficient Type 1.

F. Receive, unload, set and align all separately shipped motors; adjust and align drive and adjust belt tension.

4.2 ELECTRICAL CHARACTERISTICS FOR MOTORS SHALL BE AS FOLLOWS:

A. Fractional horsepower motors, and smaller:

<table>
<thead>
<tr>
<th>Voltage Rating</th>
<th>Operating Range</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 Volt</td>
<td>105 V - 130 V</td>
<td>Single</td>
</tr>
<tr>
<td>208 Volt</td>
<td>180 V - 240 V</td>
<td>Single</td>
</tr>
</tbody>
</table>

B. Motors 1.0 horsepower and larger:

<table>
<thead>
<tr>
<th>Voltage Rating</th>
<th>Operating Range</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>480 Volt</td>
<td>460 V - 490 V</td>
<td>Three</td>
</tr>
</tbody>
</table>

4.3 Conventional magnetic starters and combination starter-disconnect switches will be furnished and installed by the Electrical Contractor.

4.4 Disconnect switches for mechanical equipment will be furnished and installed by the Electrical Contractor, unless specifically noted otherwise on the Drawings or within these Specifications.

4.5 Wiring of electric motors and starters furnished in connection with mechanical work, including mounting of starters, will be done under Division 26 Electrical.

4.6 Interconnecting wiring for water heater controls and temperature controls shall be furnished and installed complete under Division 15, Mechanical.

A. All line voltage wiring shall be installed in EMT conduit.

B. All low voltage wiring in boiler rooms and mechanical equipment rooms shall be installed in EMT conduit.

C. Low voltage wiring installed above suspended ceilings may be run "loose" if adequately securely at 4’ intervals to insulated piping or structural members. All low voltage cable installed in ceiling plenums shall be "Plenum-Rated" for installation in an air distribution plenum.

4.7 Complete wiring diagrams for all mechanical equipment, systems and controls shall be provided under Division 23, Mechanical.

4.8 All wiring done in connection with mechanical systems and equipment, shall be installed to meet the requirements of Division 16, Electrical.

END SECTION
SECTION 22 05 14
PIPING SPECIALTIES FOR PLUMBING

PART 1 - GENERAL

1.1 SHOP DRAWINGS

A. Required.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Two and one-half inch (2-1/2") dial, steel case, seamless phosphor bronze Bourdon tube, forged brass socket, black adjustable pointer with white background and black figures, ±3% accuracy; range = 150% of working pressure; normal operation to be mid-range.

B. Gauge Valves: 1/4 inch NPT female connection, brass bar stock needle valve; 600 PSI and 300 degrees F. (maximum).

C. Ametek/U.S. Gauge Series P500 or equal product by Trerice, Ashcroft, Marsh or Weksler.

2.2 THERMOMETERS

A. Three inch (3") dial, stainless steel case, bi-metal operation, black adjustable pointer with white background and black figures, adjustable-angle head, 2% accuracy; range = 0 - 250 degree F.

B. Ametek/U.S. Gauge Series 6000 or equal product by Trerice, Ashcroft, Marsh or Weksler.

2.3 STRAINERS

A. Bronze construction, screwed connections as required, line size, Y-type, stainless steel screen with 20 mesh openings. Provide pipe extension with full port ball valve and cap.

B. Spirax/Sarco Type IT (or any equal product).

2.4 SLEEVES

A. Where piping passes through new concrete floors above grade or roof, install 22 gauge galvanized steel sleeves, large enough to avoid restriction. In finished areas where floor wetting will occur, sleeves shall consist of galvanized steel, projecting 1/4" above finished floor. In all mechanical equipment rooms not installed on grade, sleeves shall consist of 20 gauge galvanized iron pipe, projecting 1" above floor.

B. Use steel pipe sleeves in masonry walls sized to pass insulated or bare piping without restriction.

C. Long continuous piping sleeves may be Schedule 10 black steel pipe with standard or grooved fittings.

2.5 WALL, FLOOR AND CEILING PLATES

A. Based on products by Grinnell, Frost or Dearborn Brass.
B. Plates shall be steel split-type, nickel or chromium plated. Plates shall be large enough to conceal entire sleeve. Use type with set screw at ceiling.

C. Where sleeves project 1/4" above floor, use plates with raised hood.

PART 3 - EXECUTION

3.1 PRESSURE GAUGES

A. All gauges shall be installed so they are easily read, not more than 8 feet above floor.

B. Use gauge valves at all gauges.

3.2 THERMOMETERS

A. All thermometers shall be installed so they are easily read, not more than 8 feet above floor.

B. Provide wells for all thermometers.

C. Adjust thermometer head angle for best viewing.

3.3 STRainers

A. Provide strainers where shown on Project Drawings.

B. After 48 hours of system operation, blow-out strainer by means of ball valve, remove screen, clean and reinstall.

3.4 WALL SLEEVES

A. If omitted, split steel pipe horizontally, insert around piping through wall and tack weld. Patch and repair wall to match adjacent.

B. Sleeves passing through building expansion joints shall be two section with break at joint.

3.5 WALL, FLOOR AND CEILING PLATES

A. Install plates on uncovered piping passing through walls, floors or ceiling of finished rooms.

B. Unfinished areas (unpainted walls, no finish floor or ceiling) do not require plates.

END SECTION
PART 1 - GENERAL

1.1 SCOPE

A. Piping will have all openings capped and shall be tested before any painting or covering is done.

1. Testing shall be conducted in the presence of the Owner's representative, the Engineer or their representative. Contractor shall notify the Engineer of proposed tests at least two days prior to testing.
2. Respective piping contractor shall provide all equipment required to conduct tests.

PART 2 - EXECUTION

2.1 Piping systems shall be tested as hereafter specified; but not less than 50% above the operating pressure of the system.

<table>
<thead>
<tr>
<th>System</th>
<th>Test</th>
<th>Test Pressure</th>
<th>Hold Period</th>
<th>Permissible Pressure Drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Water Distribution</td>
<td>Hydrostatic</td>
<td>150 PSIG</td>
<td>4 Hrs.</td>
<td>None</td>
</tr>
<tr>
<td>Drain, Waste, Vent</td>
<td>Hydrostatic</td>
<td>5 PSIG</td>
<td>2 Hrs.</td>
<td>None</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Pneumatic</td>
<td>100 PSIG</td>
<td>24 Hrs.</td>
<td>None</td>
</tr>
<tr>
<td>Building Sewer</td>
<td>Hydrostatic</td>
<td>5 PSIG</td>
<td>15 Min.</td>
<td>None</td>
</tr>
</tbody>
</table>

2.2 All defects discovered during the tests shall be immediately corrected and piping system shall be retested until it qualifies. Defective joints found in welded piping shall be ground off and rewelded; screwed joints shall be disassembled, cleaned and rejoined as a new joint.

2.3 GAS SYSTEMS: After testing is completed, fill system with gas and soap test all joints for leaks; or test with gas detection meter.

2.4 Piping connected to specialties, or equipment with a lower pressure rating than specified test, shall be left unconnected or valved-off during test.

PART 3 – EXECUTION

3.1 NOT USED

END SECTION
SECTION 22 05 23
GENERAL DUTY VALVES FOR PLUMBING

PART 1 - GENERAL

1.1 SHOP DRAWINGS

A. Required.

PART 2 - PRODUCTS

2.1 VALVES (PLUMBING)

A. Based on products by Milwaukee.

1. Conbraco, Hammond, and Nibco equals are acceptable.

B. Water Systems (50 - 200 Degrees F.):

1. Isolation and service valves (2" and smaller):
   a. Milwaukee #BA-400 (threaded) (or BA-400S (solder)), bronze ball valve, blowout-proof stem, two-piece body, full port, 600 psi WOG.

2. Isolation and service valves (2-1/2" and larger):
   a. Milwaukee #ML-233E lug style butterfly valve, ductile iron body, EPDM liner, 200 psi WOG. Provide standard lever lock operators for all butterfly valves unless noted otherwise on the Drawings.

3. Check valves (1/2" - 3"):
   a. Milwaukee #509, bronze body swing check, renewable bronze seat and check, one-piece body, 200 psi WOG.

4. Drain valves (1/2" – 3/4"):  
   a. Milwaukee #BA-100H (threaded), bronze ball valve with hose end, brass cap and brass chain, two-piece body, conventional port, 600 psi WOG.

2.2 GAS COCKS AND VALVES

A. Based on products by Milwaukee and Dezurik.

1. Conbraco, Hammond and Nibco equals are acceptable for Milwaukee valves.

2. Walworth equals are acceptable for Dezurik.

B. Gas Valves, (2" and smaller), Milwaukee #BA475-TH (threaded), bronze ball valve, two-piece body, full port, 600 psi W.O.G. with AGA-rating for use with natural gas and L.P. Gas. Provide "Tee" handles for all gas valves.

C. Gas Valves, (2-1/2" and larger), Dezurik 425-F lubricated gas cock with flanged connections and square post operating shaft.

PART 3 - EXECUTION

3.1 VALVES (GENERAL USE)

A. Install valves where indicated, full size of piping unless noted otherwise on the Drawings.

B. Drain valves shall be 1/2 inch (unless noted ¾" on the Drawings) with standard hose ends. Provide screw-on-caps where located above suspended ceilings or other locations where water damage could occur.
C. Plumbing

1. Install valves in piping to isolate all equipment.
2. Install other valves where indicated on Drawings and Details.
3. Valve openings shall be full port in all applications.

END SECTION
PART 1 - GENERAL

1.1 SHOP DRAWINGS

A. Not required.

PART - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Based on products by Fee & Mason.
   1. Elgen, Grinell, Michigan and Unistrut equals are acceptable.

B. Individual pipe attachments shall conform to the following:
   1. Insulated Steel Pipe & Copper Tubing:
      a. Up to 8" pipe: Figure No. 103 - clevis hanger for insulated pipe.
   2. Bare Copper Tubing:
      a. Up to 4" pipe: Figure No. 300 plastic coated tubing

C. Where thermal expansion in excess of 1/2 inch is anticipated (generally straight heating main runs exceeding 50 feet in length), use Fee & Mason Figure No. 272 adjustable roller hanger.

D. Unistrut Series 2000 trapeze hangers consisting of 1-5/8-inch channels hanger rods and bolts (or as specifically mentioned by Model Number on the drawings) (with inserts, beam clamps, pipe clamps and pipe rollers similar to items specified above) may be used for piping runs.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. Individual pipe hangers shall be furnished and installed by the respective Mechanical Contractor.

B. Trapeze-type hangers to be shared with all mechanical trades shall be provided by the HVAC piping contractor where specifically noted on the Drawings.

C. Pipe hangers shall be rated for the load to be carried. Where loads are excessive, furnish heavier duty equipment or reduce spacing. Include all supplemental angles, channels, plates, etc. of adequate size and design, where supports shall be required between building structural members.

D. Hangers shall be arranged as not to cause undue strain, located near or at change in direction and at concentrated loads. They shall provide vertical adjustment to maintain proper pitch and shall allow for expansion and contraction in the piping.

E. No dissimilar support shall come in contact with copper piping; use rubber or fabric isolator between plastic or copper pipe and steel clamp.
F. Horizontal steel pipe shall be supported as below:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Diameter</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ thru 1 inch</td>
<td>3/8 inch</td>
<td>5 feet</td>
</tr>
<tr>
<td>1-1/4 thru 2 inch</td>
<td>3/8 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>2-1/2 thru 3 inch</td>
<td>½ inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>4-5 inch</td>
<td>5/8 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>6 thru 8 inch</td>
<td>¾ inch</td>
<td>10 feet</td>
</tr>
</tbody>
</table>

G. Horizontal lines of copper tubing shall be supported as below:

<table>
<thead>
<tr>
<th>Nom. Tubing Size</th>
<th>Rod Diameter</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1-1/4 inch</td>
<td>3/8 inch</td>
<td>5 feet</td>
</tr>
<tr>
<td>1-1/2 and 2 inch</td>
<td>3/8 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>2-1/2 and 3 inch</td>
<td>½ inch</td>
<td>10 feet</td>
</tr>
</tbody>
</table>

H. Gas piping shall be supported on individual hangers only.

I. Support horizontal cast iron pipe with one hanger for each pipe length, located close to hub, but not more than 5 feet on center.

J. Structural attachments shall be as hereafter specified.

1. Attach to concrete using Grinnell #285 lightweight concrete insert for loads up to 400 pounds and #282 universal insert for loads up to 1,430 pounds.

2. Attach to steel beams using Grinnell #131 malleable iron I-beam clamp for piping 6 inch diameter or less.

K. Where inserts are omitted, used two (2) Phillips expansion shields with Unistrut channel, for each hanger (or as noted on the Drawings).

L. Continuous threaded rods shall be used wherever possible and shall be cadmium plated, except above suspended ceilings.

M. No wood supports will be allowed. Do not pierce ducts with hanger rods.

3.2 PLASTIC PIPE SUPPORTS

A. Horizontal PVC piping (polyvinyl chloride) shall be supported on plastic supports and hangers or on steel padded split ring or clevis hangers as follows:

Maximum Spacing (feet)

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>SCH. 40</th>
<th>SCH. 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ thru 1-1/4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1-1/2 thru 2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3 and over</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

B. Plastic DWV piping shall be supported at intervals of not more than 4 feet, at the end of branches and change of direction or elevation, and at all closet bends.

C. On PVC piping 4 inch and larger, use Potter-Roemer "PR" insulators around pipe at all hanger points.

D. Do not clamp plastic piping too tightly.
E. Plastic piping shall be free to move sideways; installation should not be rigid.
F. Conform to manufacturer's latest support recommendation.

3.3 NO-HUB CAST IRON SUPPORTED PIPING SUPPORTS

A. Vertical piping shall be secured and supported at sufficiently close intervals to keep the system in alignment and to adequately support the weight of the pipe and its contents.

B. For horizontal piping using stainless steel bands, hangers or supports shall be provided for at least every other joint except that when the developed lengths between supports exceeds four (4) feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection.

C. Hangers, supports, or blocks, shall be adequate to maintain alignment and prevent sagging or joint separation and shall be placed on, or immediately adjacent to, the couplings. Where hubless components are suspended by means of non-rigid hangers, longer than eighteen (18) inches, they shall be suitably braced to prevent horizontal movement.

D. Piping laid on grade or in trenches, shall be continuously supported on undisturbed earth, or compacted fill or masonry blocks on solid ground under each coupling. Vertical sections and their connecting branches shall be adequately staked and fastened to driven steel pipe or reinforcing bars so as to remain stable while backfill is placed or concrete is poured.

END SECTION
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PART 1 - GENERAL

1.1 SCOPE

A. Identify all mechanical piping as herein after specified under "EXECUTION".

1.2 SHOP DRAWINGS

A. Required.

PART - PRODUCTS

2.1 IDENTIFICATION - PIPE

A. Based on products by Seton Nameplate Corporation.
   1. W.H. Brady Company equals are acceptable.
   2. Seton "Opti-Code" pressure-sensitive vinyl markers shall be used on all piping/insulation. Furnish as per manufacturer's recommendations, color coded as per ANSI Specifications.

2.2 SOLID COLOR CODING (PAINTING)

A. For all L.P. gas piping - Yellow.

B. The Mechanical Contractor shall be responsible for all painting of gas piping. All gas piping shall be painted.

C. Pipe shall receive one (1) coat of primer and one (1) final coat of gas and oil resistant epoxy final coat.

D. Primer shall be Rust-Oleum #9100 High-performance epoxy (or approved equal product).

E. Final coat shall be Rust-Oleum #9400 "Rust-O-Thane” (or approved equal product).

PART 3 - EXECUTION

3.1 IDENTIFICATION – PIPE

A. The Mechanical Contractor shall apply markers to all new or newly insulated exposed piping of this contract in equipment rooms, accessible pipe spaces, unfinished storerooms and concealed piping above suspended ceilings, as follows:
   1. Intervals of 30 feet, but at least once in every room.
   2. In equipment rooms, at each change of direction of piping 10 foot or longer.
   3. Conform to the following schedule:

<table>
<thead>
<tr>
<th>O.D. of PIPE or COVERING</th>
<th>HEIGHT OF LETTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thru 1-1/4 inch</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>1-1/2 inch to 2 inch</td>
<td>3/4 inch</td>
</tr>
<tr>
<td>2-1/2 inch to 3-1/2 inch</td>
<td>1-1/4 inch</td>
</tr>
</tbody>
</table>
4. Stencil wording shall be as follows:
   DOMESTIC COLD WATER (*)
   DOMESTIC HOT WATER (*)
   DOMESTIC HOT RECIRCULATION (*)
   NON-POTABLE WATER (*)
   NATURAL GAS (*)
   PLUMBING VENT (*)
   SANITARY DRAIN (*)
   STORM DRAIN (*)
   (*) = Add flow direction arrow to these designations.

B. Install Seton identification pipe markers as recommended by manufacturer.

3.2 SOLID COLOR CODING (PAINTING)

A. All gas piping shall be painted as specified. Color shall be "High visibility yellow" (Rust-Oleum #9448).

B. All gas vent piping shall be painted same as gas piping. This includes all vent piping from the gas train connections complete until piping exists building.

END SECTION
SECTION 22 05 76
DRAINS AND CLEANOUTS

PART 1 - GENERAL

1.1 SCOPE
A. The requirements of Section 22 05 00 apply to this Section.

1.2 SHOP DRAWINGS
A. Required.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS
A. (Floor drains are scheduled on the Drawings.)

2.2 CLEANOUTS
A. In Concrete Floors: (CO-1) J.R. Smith Fig. 4023 or 4033 or 4028 with spigot, speedi-set, or caulk outlet, cast iron adjustable cleanout with round scoriated N.B. cover and bronze plug or Schier No. T-100-RS or T-1090-RS adjustable access cover with round tennalloy scoriated top and No. 101-PVC series PVC plug and socket connection (3", 4" and 6" sizes): or Schier No. TRC-303 series adjustable PVC cleanout with round tennalloy metal ring and scoriated cover.

B. In Resilient or Ceramic Tile Floor: J.R. Smith Fig. 4043, or 4053, or 4048 with spigot, speedi-set or caulk outlet, cast iron adjustable cleanout with square scoriated N.B. cover and bronze plug; or J.R. Smith Fig. 4163 or 4173, or 4168 with spigot, speedi-set or caulk outlet, cast iron adjustable c.o. with square N.B. top with 1/8" recess to receive resilient tile; or Schier No. T-100-RS or T-109-RS round tennalloy scoriated top with No. 101 PVC series PVC plug and socket connection (3", 4", and 6" sizes); or Schier No. TRC-303 series adjustable PVC cleanout with round tennalloy metal ring and scoriated cover.

C. In carpet floor: as specified for concrete floors, but to include carpet marker.

D. In walls: Install a threaded bronze countersunk plug with gasket. In finished rooms install a J. R. Smith Fig. 4710 cleanout access with round prime coat cover over plug, for painting out wall.

PART 3 - EXECUTION

3.1 FLOOR DRAINS
A. Adjust flush with top of finished floor.

B. Flash and clamp waterproof membrane into collar.

C. Floor drains that are located in certain areas or serving specific equipment, which cannot maintain the trap seal, shall be provided with a mechanical trap primer connecte to the domestic water system in a manner approved by the local, state and Model building Codes.

D. Neatly apply G.E. Silicone sealant of color to blend in with floor, around pipe to seal floor penetration watertight. (Upper floor level only.)
3.2 CLEANOUTS

A. Provide cleanout in drainage lines where stoppages may occur, at each change in pipe size, and in full compliance with all applicable Codes, in particular, State Plumbing Codes.

B. Cleanouts under floor are to be brought up flush with finished floor level.

C. Cleanouts shall be readily accessible, with adequate clearance to properly clean pipe.

D. Cleanouts shall open in the direction of flow or perpendicular to the flow.

E. Provide cleanout within 5 feet of where the building drain and the building sewer connect.

F. Cleanout plugs may be either brass.

G. Cleanouts shall not exceed: 75 feet apart for horizontal drains and 100 feet for building sewers.

H. Exterior cleanouts shall be provided with a frost sleeve extending from grade to within 12" of sewer main. Sleeve may be sch. 40 or SDR PVC or cast iron. Cleanout body and plug shall be flush with grade. In vehicular traffic areas, provide a square concrete pad four inches thick and nine inches beyond edge of cleanout body.

END SECTION
PART 1 - GENERAL

1.1 SCOPE

A. Insulate all piping systems as specified herein.

1.2 SHOP DRAWINGS

A. Required.

PART 2 - PRODUCTS

2.1 PIPE INSULATION COVERING

A. Based on products by Owens-Corning.

1. Certainteed, Manville and Knauf equals are acceptable. Pipe insulation and components shall meet ASTM E-84, NFPA 255 or U.L. 723 tests, Flame Spread 25 and Smoke Developed 50.

B. Hot Piping, Concealed or Exposed Indoors:

1. Maximum temperature +850 degrees F.
2. O-C “SSL II” fiberglass insulation with factory applied "ASJ" jacket secured with self-sealing laps and butt strips.
3. Fittings shall be insulated with pre-molded, one piece PVC insulated fitting covers. Fiberglass insulation insert thickness shall be equal to or better than adjacent pipe insulation.
4. Thermal conductivity: R = 4.3 / K = .23 at +75 degrees

C. Hot Piping, Insulation Thickness: Provide as scheduled below:

<table>
<thead>
<tr>
<th>Fluid Piping Systems Type</th>
<th>Temp. Range Degree F.</th>
<th>Run Outs Up to 3/4”</th>
<th>1” and Less</th>
<th>1-1/4-2”</th>
<th>2-1/2-4”</th>
<th>5” - 6”</th>
<th>8” an Larger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumbing:</td>
<td>Domestic Hot Supply</td>
<td>½”</td>
<td>1”</td>
<td>1”</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Domestic Recirculation Water</td>
<td>½”</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. Cold Piping, Concealed or Exposed Indoors:

1. Minimum temperature +35 degrees F.
2. O-C “SSL II” fiberglass insulation with factory applied "ASJ" jacket secured with self-sealing laps and butt strips.
3. Fittings shall be insulated with pre-molded, one piece PVC insulated fitting covers. Fiberglass insulation insert thickness shall be equal to or better than adjacent pipe insulation.
4. Thermal conductivity: \( R = 4.3 / K = .23 \) at +75 degrees F.

E. Cold Piping, Insulation Thickness: Provide as scheduled below:

**Insulation Thickness in Inches for Pipe Sizes**

<table>
<thead>
<tr>
<th>Fluid Piping Systems Type</th>
<th>Temp. Range Degree F.</th>
<th>Run Outs Up to 3/4”</th>
<th>1” and Less</th>
<th>1-1/4-2”</th>
<th>2-1/2-4”</th>
<th>5”- 6”</th>
<th>8” and Larger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumbing: Domestic Cold Supply</td>
<td></td>
<td>½”</td>
<td>½”</td>
<td>¾”</td>
<td>1”</td>
<td>1”</td>
<td>N/A</td>
</tr>
<tr>
<td>Non-potable Water</td>
<td></td>
<td>N/A</td>
<td>½”</td>
<td>¾”</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Stormwater and Clearwater</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1”</td>
<td>1”</td>
<td>1”</td>
</tr>
</tbody>
</table>

**PART 3 - EXECUTION**

3.1 Pipe Insulation Covering

A. All hot and cold piping covering shall be continuous through sleeves and openings. Covering shall be installed as per the manufacturer's recommendations, by a qualified insulation subcontractor, after piping has been tested, as specified.

B. All insulation shall be equal to or better in thermal efficiency than the base specification, or additional thickness shall be provided.

C. Provide for operation and viewing of all nameplates, controls, instruments, valve bonnets and stems. Insulate flanges, valve bodies, strainers, etc. as hereafter specified:

1. Flanges:
   a. Hot piping: Insulation shall stop at flanges to allow access to bolts, with ends of insulation finished.
   b. Cold piping: Provide pre-manufactured PVC insulation cover with fiberglass insulation insert.

2. Valves:
   a. Hot piping: Insulation shall stop at flanges to allow access to bolts, with ends of insulation finished.
   b. Cold piping: Provide pre-manufactured PVC insulation cover with fiberglass insulation insert. Cover entire valve. Provide valve handle extensions as required so full thickness of insulation covers entire area of valve.

3. Accessories and specialties such as thermometer wells, gauge tappings, etc. will be insulated as if straight section of piping or typical fitting. Mark location of specialties on insulation in a neat manner.

D. Pipes shall be clean and dry before insulation is applied.

3.2 Plumbing Piping Insulation

A. All domestic hot, cold, re-circulating and non-potable plumbing piping shall be insulated, except as follows:
1. Underground cold water piping will not be insulated.
2. Exposed domestic chrome plated water piping at fixtures will not be insulated.
3. Non-chrome piping of any size, concealed in wall cavities, shall be insulated complete to the fixture valves.

B. All rainwater, stormwater, and Clearwater waste from HVAC condensate drains shall be insulated complete, including:
   1. Roof drain bodies.
   2. All horizontal piping, exposed or concealed.
   3. All vertical piping, exposes or concealed.
   4. Underground piping will not be insulated.

C. Roof drain bodies: Roof drain bodies may be insulated with 1 inch thickness of rubber insulation in black or white color, at the Contractor’s option.

END SECTION
SECTION 22 11 13
FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SCOPE
   A. The requirements of Section 23 05 00 apply to this Section.

1.2 Related Work Specified Elsewhere
   A. Pipe/Valve Identification: Section 22 05 53.
   B. Piping Support Devices: Section 22 05 29.
   C. General Duty Valves Section 23 05 23.
   D. Pipe Insulation: Section 22 07 19.

1.3 SHOP DRAWINGS
   A. Required.

PART 2 - PRODUCTS

2.1 WATER SERVICE TO BUILDING
   A. (Provided and installed by others under Separate Contract. The Site work contractor will bring any new water service into the building, will seal the exterior building penetration, and will supply a standard ANSI flange for connection by others. The Plumbing Contractor shall coordinate with the Fire Sprinkler Contractor to make connections at this flange.)

2.2 PIPING ABOVE FLOOR
   A. Type L (Hard) Copper with copper wrought sweat fittings. Soft Temper copper tubing may be used when routing through wall framing members

2.3 PIPING BELOW FLOOR
   A. Type L (Soft) copper without joints or fittings, or
   B. HDPE "PEX" tubing, installed without joints or fittings below floor, with matching fittings for connection to copper fittings above floor.

2.4 WATER HAMMER SUPPRESSORS
   A. Based on product by Precision Plumbing Products, or equal. At Contractor's Option, other approved mechanical water hammer suppressors may be installed in lieu of the above. The size and location of the suppressor shall be in accord with the hydraulic design of the piping system served.
   B. Constructed of type K hard drawn copper barrel, brass piston, O'rings, Dow-Corning Silicone compound #107 seal lubricant.
   C. Shall meet either the ANSI Standard A112.26.1M or ASSE Standard 1010
D. Contractor's Option: Sioux Chief "Hydra-Rester".

PART 3 - EXECUTION

3.1 BUILDING WATER PIPING SYSTEM

A. If copper piping is used, mechanically formed tee connections may be provided in lieu of wrought copper fittings. Joints shall be brazed using Sil-Fos. System shall be approved by Wisconsin Plumbing Code and shall be submitted for written approval of A/E. Viega system compression fittings will also be allowed.

B. Piping shall be pitched to drain entire system; install drain valves at low points. Provide unions, at piping connections to all equipment, control valves, etc.

C. No water piping shall be installed in exterior walls above grade.

D. At each high point where air may be trapped in water distribution mains 3/4" and larger, install 1/2" air vent line with valve or a fixture branch off top of main.

E. Use dielectric unions/brass converter fittings/flanges for connecting dissimilar piping materials, copper and steel or cast iron pipe or fittings. When pipe flanges are utilized, copper systems shall have bronze flanges and steel/cast iron systems shall have ferrous material flanges. Both shall be isolated from the other via gasket and thru bolts isolated from flanges via insulating bushings or grommets.

F. Extend hot and cold water piping from water heater/water meter and connect to all fixtures and equipment as required.

G. Seal all openings around piping and pipe sleeves penetrating walls, floors and ceilings, including areas above suspended ceilings.

H. No piping shall be permitted to be installed in, enter or pass through spaces dedicated for electrical switchboards, panel boards, distribution boards, etc. Dedicated spaces extend from floor to structural ceiling with a width and depth that of the electrical equipment plus the working space in front of same with a width matching the equipment but not less than 30 inches, a depth of 36 inches and a height to at least 75 inches above floor. (Sections 110-16 and 384-4 of NFPA 70.)

I. Provisions for draining system shall be accomplished via 1/2" valve, whereby air can be used to blow system clear of standing water.

3.3 TESTS

A. Before joints are covered. (Refer to Section 23 05 93).

3.4 FLUSHING

A. Upon completion of the water distribution system, test all valves to insure their full opening and flush out the system progressively by opening fire hydrants/building outlets and permitting the flow to continue from each until the water runs clear.

3.5 STERILIZATION

A. As soon as the water distribution system has been flushed out as above specified, it shall be sterilized in accordance with the requirements of the State of Wisconsin, Department
of Commerce, Bureau of Plumbing or, in the absence of such, by the following method:

1. Introduce chlorine or a solution of calcium or sodium hypochlorite, filling the lines slowly and applying the sterilizing agent at a rate of 50 parts per million of chlorine, as determined by residual chlorine tests at the ends of the lines. Open and close all valves and hydrants while the system is being chlorinated.

2. After the sterilizing agent has been applied for 24 hours, test for residual chlorine at the ends of the lines. If less than 5 P.P.M. is indicated, repeat the sterilization process.

3. When tests shown at least 5 P.P.M. of residual chlorine, flush out the system until all traces of the chemical used are removed.

4. Submit potable water sample, taken at the most remote location, to a certified testing agency and submit copy of test report to the Engineer.

3.6 WATER HAMMER SUPPRESSORS

A. Install as per manufacturer's recommendations of type indicated on Drawings.

B. All water hammer arrestors shall be accessible.

C. Each fixture, equipment or device with quick closing valves or which may create water hammer shall be provided with water hammer suppressors. At least one water hammer arresting shall be supplied at each toilet room with flush valve flushing mechanisms. Water hammer arrestors shall be provided at all ice makers, water dispenser or valve box connections, at all laundry equipment, and at all trap primmers.

D. Install water hammer suppressors at the ends of long pipe runs as indicated on drawings.

E. All water hammer suppressors shall be equipped with an isolation valve so the water hammer suppressor can be removed and replaced without disrupting water flow to the building.

END SECTION
PART 1 - GENERAL

1.1 SCOPE

A. The requirements of Section 23 05 00 apply to this Section.

B. Note: Many areas of this building utilize the ceiling plenum as a return air path. For this reason, as well as noise suppression, only cast iron piping systems will be allowed above the grade level floors. Cast iron piping with no-hub couplings are recommended. At the Contractor’s option, fire-resistant plastic piping systems, such as Spears “Labwaste” system, may be used in lieu of cast iron in all applications. Alternative systems may be acceptable, with Engineer review and approval.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Pipe Identification: Section 22 05 53.

B. Piping Support Devices: Section 22 05 29.

1.3 RECORD DATA

A. Record installed building drain and sewer elevations on "As-Built Drawings".

1.4 SHOP DRAWINGS

A. Not required.

PART - PRODUCTS

2.1 PIPING BELOW FLOOR (BUILDING DRAINS)

A. Schedule 40 PVC DWV pipe and fittings.

2.2 PIPING ABOVE FLOOR (DRAIN, WASTE AND VENT)

A. No-Hub cast iron pipe and fittings.

PART 3 - EXECUTION

3.1 SANITARY DRAIN, WASTE AND VENT

A. Changes in direction of drainage piping shall be made with 45 degree wyes, long or short sweep quarter bends, sixth, eighth, or sixteenth bends, or combination of these or other equivalent fittings. Fittings shall be installed as to make for least possibility of stoppage.

B. The minimum pitch of horizontal branch drains: Two inches or less in diameter shall be 1/4 inch per foot; larger than two inches in diameter shall be 1/8 inch per foot.

C. Connect to all fixtures and equipment, as required.

D. Sleeve all piping penetrating floors and seal. Extend sleeves one inch above finished floor.
E. Extend piping cleanouts through floor above.

F. Each plumbing fixture shall be separately trapped and such trap shall be effectively protected against syphonage or backpressure.

G. Pitch vent piping to drain back to a drainpipe.

H. Connect vent piping to horizontal drain piping at point above the horizontal centerline of the drain piping.

I. Vent pipes passing through roof shall extend 8 inches above roof. Flashing provided by Roofing Contractor on all single membrane roofing systems. Plumbing vents shall be located at least:
   1. 20 feet from windows, doors, air intakes or scuttles;
   2. 5 feet from exhaust vents or parapet walls.

J. Install indirect waste piping and local waste piping draining fixtures, appliances, and devices having public health concerns, as follows:
   1. Piping shall be accessible for flushing and cleaning.
   2. Indirect waste piping and sanitary local waste piping greater than 30 inches long shall be trapped.
   3. Indirect waste piping draining refrigerated compartments shall be trapped.
   4. Piping shall discharge into a receptor excluding plumbing fixtures used for domestic or culinary purposes.

K. Seal openings around piping and pipe sleeves penetrating walls, floors and ceilings including areas above suspended ceilings.

L. No piping shall be permitted to be installed in, enter or pass through spaces dedicated for electrical switchboards, panel boards, distribution boards, etc. Dedicated spaces extend from floor to structural ceiling with a width and depth that of the electrical equipment plus the working space in front of same with a width matching the equipment but not less than 30 inches, a depth of 36 inches and a height to at least 75 inches above floor.

END SECTION
PART 1 - GENERAL

1.1 SCOPE

A. The requirements of Section 22 05 00 apply to this Section.

B. Note: Many areas of this building utilize the ceiling plenum as a return air path. For this reason, as well as noise suppression, only cast iron piping systems will be allowed above the grade level floors. Cast iron piping with no-hub couplings are recommended. At the Contractor’s option, fire-resistant plastic piping systems, such as Spears “Labwaste” system, may be used in lieu of cast iron in all applications. Alternative systems may be acceptable, with Engineer review and approval.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. None.

1.3 SHOP DRAWINGS

A. Not Required.

PART 2 - PRODUCTS

2.1 PIPING BELOW FLOOR INSIDE BUILDING FOUNDATION WALLS

A. Schedule 40 PVC DWV pipe and fittings. All pipe and fittings shall conform to ASTM D-2665.

B. All fittings shall be socket-type designed for solvent-weld assembly per ASTM D-2665.

2.2 PIPING BELOW GRADE INSTALLED EXTERIOR TO THE BUILDING FOUNDATION WALLS

A. Schedule 40 PVC DWV pipe and fittings. All pipe and fittings shall conform to ASTM D-2665.

B. All fittings shall be socket-type designed for solvent-weld assembly per ASTM D-2665.

2.3 PIPING ABOVE GRADE INSTALLED INSIDE THE BUILDING

A. No-Hub cast iron pipe and fittings.

PART 3 - EXECUTION

3.1 STORMWATER PIPING

A. Changes in direction of drainage piping shall be made with 45 degree wyes, long sweep quarter bends, sixth, eighth, or sixteenth bends, or a combination of these or other equivalent fittings. Fittings shall be installed as to make for least possibility of stoppage.

B. The minimum pitch of horizontal branch drains: Two inches or less in diameter shall be 1/4 inch per foot; larger than two inches in diameter shall be 1/8 inch per foot.
C. Coordinate drain locations with the General Contractor. Adjust piping routes as required.

D. Refer to Specification Section 22 05 00 and the Details on the Drawings for responsibilities for excavation, backfill, and site restoration. The Contractor is reminded that all exterior, underground piping shall be laid on a gravel or crushed rock bed.

END SECTION
PART 1 – GENERAL

1.1 RELATED DOCUMENTS
A. The requirements of Section 22 05 00 apply to this Section.

1.2 RELATED DOCUMENTS
A. General-Duty Valves for Plumbing Piping: Section 22 05 23
B. Electrical: Division 26 00 00

1.3 REFERENCE
A. Applicable provisions of Division 1 shall govern work under this section.

1.4 QUALITY ASSURANCE
A. Substitution of Materials: Refer to General Conditions of the Contract.

1.5 SHOP DRAWINGS
A. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.6 SUBMITTALS
A. Required.
B. Submit information on the sump, sump cover, pump, with all operating characteristics proposed for this project, and pump controls.

PART 2 – PRODUCTS

2.1 ELEVATOR SUMPS
A. Polyethylene sump basin with minimum dimensions of 30 inches deep by 18 inches in diameter. Basin shall have no piped inlets. Equipment basin with a special "elevator duty" top with numerous holes drilled to allow for ground water to enter the sump through the cover, not requiring use of a separate floor drain.

B. Products by Topps Industries are recommended.

2.2 SUMP PUMPS – EFFLUENT PUMP
A. Pump shall have a minimum capacity of 20 GPM against 25 Ft. Hd.
B. Type: Submersible pump constructed of epoxy coated cast iron shell, cast iron volute, two vane enclosed non-clog, bronze impeller, stainless steel shaft, stainless steel
fasteners, upper and lower ball bearings, oil lubricated or factory sealed grease lubricated, and ceramic mechanical seal, 1-1/2 inch pipe discharge.

C. Motor: Hermetically sealed, capacitor start, with built-in thermal overload protection sized for non-overloading over the entire pump curve.

2.3 CONTROLS: - EFFLUENT PUMP CONTROLS

A. Single pump-mounted float for on-off control with minimum of 8 foot cord suitable to receive pump plug for automatic control.

B. Provide and install separate NEMA 1 indoor alarm panel with warning light, horn, silence switch, test switch and hermetically-sealed float.

2.4 ACCESSORIES:

A. Discharge check valve, fullport ball valve and union for each pump.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.

B. Set pump directly in sump on support feet supplied with pump.

C. Install discharge piping to allow for easy removal of pump with minimal piping disassembly. When sumps and pumps are located in elevator pits, coordinate carefully with the elevator supplier and obtain direction from elevator installer for allowable locations of piping, wiring and equipment.

D. The Electrical Contractor will supply a GFCI-protected outlet for pump power and control.

E. The Plumbing Contractor shall supply the high level alarm and install the control panel. The control panel shall be located in the Elevator Equipment Room as a function directly related to the operation of the elevator. The Electrical Contractor will provide a power supply to the panel, but the Plumbing Contractor is responsible to install the float, secure at the correct height, and make the low voltage connections within the High Level Alarm.

F. At completion of installation, manually actuate the pump float control to ensure pump starts, using care not to run the pump without water. Manually actuate the alarm float and ensure the alarm sounds correctly.

G. Secure the sump cover with stainless steel fasteners.

END OF SECTION
SECTION 22 42 00
COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SCOPE
A. The requirements of Section 22 05 00 apply to this Section.

1.2 SHOP DRAWINGS
A. Required.
B. Provide manufacturer literature showing exact component proposed for this project with dimensions, optional finishes, etc.
C. Provide manufacturer’s installation instructions.
D. Provide manufacturer’s literature for caulking.

PART 2 - PRODUCTS

2.1 COMMERCIAL PLUMBING FIXTURES
A. (Refer to Schedule on Drawings).
B. All fixtures shall be provided and installed with all accessories as necessary for a complete installation ready for use. Include fixture stops or isolation valves, drainage components with integral or external traps and vent provisions, mounting accessories, etc.

PART 3 - EXECUTION

3.1 CHINA AND ENAMELED FIXTURES
A. Fixtures and accessory trim shall be installed as recommended by manufacturer.
B. Space between fixture and wall or floor shall be neatly caulked with white-color Silicone-based caulking designed specifically for this type of installation.
C. Every fixture shall have its independent control valve(s) adjacent to same, chrome plated brass finish where exposed.
D. All fixtures shall be securely fastened to wall/floor construction or supported by chair carriers. Anchor bottom holes on lavatories and hand tighten. (All floor bolts in shoe of floor-mounted supports shall be securely anchored).
E. Fittings shall be securely fastened with joints watertight.
F. Install as recommended by manufacturer.
G. Connections for waste and water shall enter walls as high as possible under fixture.
H. After installation but before acceptance by Owner, all fixtures shall be protected to
prevent scratching or other construction damage.

I. Before acceptance by Owner, all fixtures shall be cleaned with compounds recommended by the respective manufacturer.

J. Urinals and Water Closets:
   1. Adjust each flushometer valve for proper flush.

3.2 COUNTERTOP SINKS

A. Fittings shall be securely fastened to sink and sink to countertop with accessories as necessary. The General Contractor will but all openings in countertops based on template or precise dimensions supplied by the Plumbing Contractor.

B. As best possible, the Plumbing Contractor shall field verify that proposed sink will fit in cabinet and countertop before ordering sink. Delay final ordering of drop-in and undercounter sinks as long as possible, without delaying construction progress.

C. Apply sealing caulk to underside of sink rim.

D. Install sink in countertop and remove excess caulk with a damp cloth and a small amount of powdered cleanser.

E. Escutcheons may be omitted only if openings in back of cabinet are neatly cut and not excessively large. (Subject to Architect's approval).

3.3 ELECTRIC WATER COOLERS

A. Typically, electric water coolers will be surface-mounted. Provide and install wall-mounting bracket supplied with electric water cooler and ensure the wall has sufficient strength to support the electric water cooler.

B. Ensure water supply and drainage connection are installed in a location with meets the manufacturer's recommended positions and will be completely covered with the water cooler enclosures.

C. Coordinate with the Electrical Contractor to ensure a GFCI-protected receptacle is installed in the correct location per the manufacturer's recommendations.

D. Mount heater and make all final water supply and drainage connections. Exposed drainage components shall be chrome-plated, 17 gauge brass. Concealed drainage components may be PVC.

E. At completion of installation, adjust water flows optimally to keep water stream as high as possible, with all normal drainage falling in the drainage area. If equipped with a bottle filler, ensure the water flow to the bottle filler is fully open.
PART 1 - GENERAL

1.1 SCOPE

A. The requirements of Section 22 05 00 apply to this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Water Distribution Piping System: Section 22 11 13

1.3 APPLICABLE STANDARDS

A. State and Local Codes.
B. UL or AGA or ASME.
C. ASHRAE 90A.

1.4 SHOP DRAWINGS

A. Required.
B. Provide manufacturer’s literature noting the exact model of water heater proposed to be used.
C. Include complete list of all accessories proposed to be supplied with the heater.

PART 2 - PRODUCTS

2.1 WATER HEATERS

A. (Refer to Schedule on Drawings)
B. In all cases, the Contractor shall supply all components and accessories as necessary for a complete installation and as required or recommended by the manufacturer of the water heater.
C. All tank-type water heaters, regardless of fuel, shall be supplied with pressure and temperature relief valves. Instantaneous water heaters shall be supplied with pressure-only relief valves.
D. Provide and install isolation valves for all water heaters. Include unions or flexible equipment connectors with compression connections to allow for removal of water heaters without disturbing piping. Include a normally-closed bypass valve to allow for continued use of the hot water distribution system.
E. All water heaters shall be fitted with a drain valve. This may be a “boiler” drain directly connected to a tank-type water heater, or a piped drain valve on instantaneous water heaters. All drain valves shall be suitable for connecting a standard garden hose for draining purposes.
F. Gas-fired water heaters shall be supplied with gas venting and combustion air piping using materials as allowed by the water heater manufacturer and installed in a manner
full compliance with the manufacturer’s directions. Include suitable termination fitting as applicable for each installation.

PART 3 - EXECUTION

3.1 WATER HEATER

A. Install relief valve and extend overflow to 6” above floor. Terminate with a 45 degree saw cut.

B. Relief valve setting shall be 100 PSI or 10 psi below maximum tank working pressure and 200 degrees F temperature. Relief valves on instantaneous water heaters shall be 100 PSI.

C. The manufacturer shall assume the operations responsibility.

D. Use dielectric unions or brass converter fittings to connect copper tubing to steel tanks, heaters, or piping.

E. Provide piping, unions, valves and thermometers as detailed.

F. Furnish complete wiring diagrams for the system to the Electrical Contractor. Complete wiring of system under Division 26.

G. Electric wiring under Division 26, Electrical; including heater grounding.

H. Contractor shall make all necessary adjustments required for most efficient and safe operation. Contractor shall make all adjustments instructed by manufacturer or A/E.

I. The water heater shall be located such that all controls, relief valves are accessible for service and replacement without moving heater.

END SECTION
## SECTION 23 00 01

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END OF DOCUMENT 23 00 01
PART 1: GENERAL

1.01 RELATED DOCUMENTS
   A. Conditions of the Contract and portions of Division One of this Project Manual apply to this
      Section as though repeated herein.

1.02 WORK INCLUDED
   A. Provide all materials, labor, services and incidentals necessary for the completion of this
      Division of the Work.
   B. Requirements of Section 23 05 00 applies to applicable Sections of Division 2 and all Sections
      of Division 23.
      1. Bidding Requirements, Contract Forms, Conditions of the Contract, Division 1-General
         Requirements, and Sections 23 01 30 through 23 84 17 inclusive Heating, Ventilating, and
         Cooling Work.
   C. Cutting and Patching: Section 01 07 00.

1.03 RELATED WORK
   A. Fire Stopping: Section 07 84 00.
      1. Refer to this section for instructions and determination of responsibility.
      2. The Mechanical Trades shall submit the cost of firestopping for their Trade to the Prime
         Contractor under Section 07 84 00 Fire Stopping. The Prime Contractor shall then decide
         whether to do all of the fire stopping or assign it to the individual Trade at the submitted
         cost.
   B. Commissioning contract by Owner.

1.04 QUALITY ASSURANCE
   A. Submit Bid based on materials and equipment of manufacturers specified. Catalog numbers
      of base manufacturer establishes quality required. Other manufacturers listed may be bid
      without prior approval, providing product is equal to base specification and subject to proof of
      compliance during shop drawing review by Architect/Engineer.
      1. All items specified shall be the latest type or model produced by manufacturer specified.
         If descriptive specification or model number is obsolete, substitute current product.
   B. Whenever a product of a manufacturer other than the Base Specification is furnished, include
      in the Bid, any additional costs for labor and/or materials required to adapt the substituted
      equipment variations, to the original system design. This includes full compensation to other
      Trades for changes required in their work. Variations include, but are not limited to:
      1. Additional breeching, piping extensions, stack revisions, etc. for changes in location of
         boiler outlets.
      2. Additional piping or ductwork extensions for equipment tapping variations.
      3. Additional structural support for heavier equipment.
      4. Changes in sizes of roof curbs, equipment supports and equipment pads.
      5. Added cost for changes in electrical work; larger motors, wiring, disconnects, starters,
         lighting relocation, etc.
C. Contractor shall conform to drawings and specifications, even when there may be conditions or items specified in excess of State or local codes or regulations, unless the Contractor has notified the A/E and the documents have been modified by either an Addenda or Change Order changing or clarifying the specific matter.

D. Contractor shall contact the A/E no later than seven days before the bids are received/opened for the correct interpretation of any item on the drawing or specification needing clarification. If needed, the documents would be modified by an Addenda, changing or clarifying the specific matter.

E. All work must be performed in a workmanlike manner and according to manufacturer’s recommendations.

1.05 DRAWINGS AND SPECIFICATIONS

A. In general, the drawings of the Mechanical Systems and Equipment are to scale where possible. Drawings shall not take precedence over field measurements.

B. Plans of piping and ductwork, although shown on scale drawings, are diagrammatic only. They are intended to indicate the size and/or capacity where stipulated, approximate location and/or direction, and approximate general arrangement of one phase of work to another, but not the exact detail or exact arrangement of construction. Additional offsets, fittings, etc. required for a complete and operational system shall be the responsibility of this contractor and shall be provided and so bid and shall not result in additional costs to the owner during construction.

C. If it is found before installation of any or all construction phases, that a more convenient, suitable or workable arrangement of any or all phases of the project would result by varying or altering the arrangement indicated on the drawings, the Project Manager/Engineer may require any or all Contractors to change the location or arrangement of their work without additional cost to the Owner. Such rearrangement shall be in accordance with directions from the Project Manager/Engineer.

D. Where discrepancies are discovered after certain portions or phases of any Contract have been installed, the Project Manager /Engineer reserves the right to have any or all Contractors make minor changes in pipe, duct, fixture or equipment locations or arrangements to avoid conflict with other work at no additional cost to the Owner.

E. Because the drawings are to a relatively small scale to show as large a portion as is practical, the fact that only certain features of the system are indicated does not mean that other similar or different features or details will not be required. Contractor shall furnish all incidental labor, materials, or equipment for the systems under his control, so that each system is a complete and operating one unless otherwise specifically stipulated in the detailed body of the Specifications.

F. The Contractor shall be responsible for determining all field measurements before commencing construction, giving due consideration to building design and other equipment to be installed. Mechanical equipment not dimensioned on the drawings shall be field located, giving due consideration to the work of other trades. The Contractor shall verify all dimensions before proceeding with the work. Where cutting and patching is required, each Contractor shall be responsible for his own work, unless indicated otherwise on the drawings.

G. Dimensions shall not be scaled from the drawings. If the Contractor discovers any discrepancy between actual measurements and those shown on the drawings which prevents good practice, good arrangement, or which is contrary to the intent of the drawings and specifications, he shall notify the Project Manager /Engineer before proceeding with the work.
1.06 SITE INSPECTION
A. Before submitting a proposal for the work contemplated in these specifications and accompanying drawings, each bidder shall examine the site and familiarize himself with all the existing conditions and limitations, including the extent of demolition, cutting and patching to be done by the Contractor for Mechanical Work.
B. No additional owner costs will be allowed because of the Contractor's misunderstanding as to the amount of work involved, or his lack of knowledge of any condition in connection with the work.

1.07 REGULATORY REQUIREMENTS
A. Comply with all State and Local Codes, laws, ordinances and regulations. Comply with applicable OSHA regulations.
B. Boilers, water heaters, storage tanks and other pressure vessels shall be A.S.M.E. constructed and stamped, where required by State or Local Codes. Boilers shall be installed as per ASME Codes, by Contractor's having ASME Certification, where required.
C. Comply with and pay fees for all required reviews, approvals, permits and inspections.
D. Where drawings and specifications call for materials or workmanship in excess of these requirements, drawings and specifications shall govern.

1.08 QUALIFICATIONS FOR WELDERS
A. Welders shall be qualified to perform work in accordance with Section 9 of the ASME Code or Independent Testing Laboratory.
B. Cost to qualify welders shall be borne by Contractor.
C. Standard specification provision for the Fabrication and Erection of Piping Systems as recommended by the National Certified Pipe Welding Bureau.
   1. Piping shall comply with the provisions of the latest revision of the applicable sections of the ASME Code for Pressure Piping, ANSI/ASME B31.
   2. Boiler external piping shall comply with the latest revision of Section I of the ASME Boiler and Pressure Vessel Code, ANSI/ASME BPV-1 Power Boilers.
D. Before any welding is performed, the contractor shall submit to the Owner, or his authorized representative, a copy of his Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code.
E. Before any welder shall perform any welding, the Contractor shall submit to the Owner, or his authorized representative, a copy of the Manufacturer's Record of Welder or Welding Operator Qualification tests as required by Section IX of the ASME Boiler and Pressure Vessel Code.
F. The types and extent of the non-destructive examinations required for pipe welds are shown in Table 136.4 of the ASME Code for the Pressure Piping, ANSI/ASME B31.1-Power Piping. If requirements for non-destructive examination are to be other than that stated above, the degree of examination, and basis for the rejection shall be matter of prior written agreement between the fabricator, or contractor and the purchaser.
G. Each Contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these specifications.
1.09 DELIVERY, STORAGE AND HANDLING

A. Cover and protect all materials and equipment stored at Project Site from weather. Support above ground on temporary bases.

B. Cover all mechanical products and control devices from damage, dust, plaster and other construction debris. After installation is completed or while storing inside building, wrap and enclose all fixtures, equipment and control devices with canvas or heavy mill plastic, secured with wire or cord. Fixtures may be protected with the factory applied heavy paper or carton they are shipped in. Do not remove protection device until room or area is cleaned and free of dust and debris.

C. Handle all materials and equipment in accordance with manufacturer’s written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage.

D. Do not store or install equipment unless temperature in maintained between 32 degrees F and 104 degrees F, at a relative humidity less than 95 percent (non-condensing). Maintain conditions during and after installation of Products.

1.10 WARRANTY

A. Correct defective Work within a **two year period** after the Date of Substantial Completion.

B. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

C. Provide a 2-year warranty on all equipment. Refer to individual sections for extended warranties.

1.11 SUBMITTALS

A. Submit in accord with Section 01 30 00.

1. Descriptive product data describing all material furnished under Part 2 of this Section.

2. Submit each Specifications Section under separate cover to streamline review process.
   a) Include section number and name on cover.
   b) When multiple products are shown on a single page indicate which specific product you plan on using.
   c) Tag with equipment mark number from plans and schedules.
   d) General and Mechanical Contractors to review and stamp before forwarding on to Engineer.

1.12 ALTERNATES

A. Refer to Bid Form and Instructions to Bidders.

**PART 2: PRODUCTS**

2.01 MATERIALS, FIXTURES AND EQUIPMENT

A. Provide all new products unless otherwise indicated.

B. All pipe sizes are I.D. unless otherwise indicated.

C. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous plate on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
2.02 DRIVE GUARDS
   A. Provide guards for all belt-driven motors.
   B. Provide guards for all motor shafts.
   C. Guards shall be sheet steel, cast iron, expanded metal or wire mesh. Include access hole for speed measurement.

2.03 CONCRETE PADS AND BASES
   A. For concrete pads and bases under mechanical equipment refer to Architectural, Mechanical and Structural Drawings. Under this Section, notify other Trades, of any equipment changes that will affect sizes of pads and bases.
   B. Provide concrete equipment pads for all floor and grade mounted equipment, not indicated on Architectural or Structural Drawings. Minimum 3 ½” thick, sized for the purpose intended.
   C. Concrete work shall conform to Division 3.

2.04 STEEL SUPPORTS AND HANGERS
   A. Steel angle or pipe supports for floor mounted equipment and steel hangers for suspended equipment, including supplemental beams or angles mounted to building structure, will be furnished and installed under appropriate Mechanical Section, designed to carry total supported weight.

2.05 SERVICE OUTLETS
   A. Provide a service outlet at or near mechanical equipment.
   B. The single-phase, 15 or 20-A, 125-V receptacle required by this section is intended to be used to service HVAC & refrigeration equipment. It is required to be accessible, within 25 ft. of the equipment, and located on the same level as the equipment. If the equipment is at grade level, the receptacle must be installed at that level; however, if it is a rooftop unit, the receptacle is required to be located on the rooftop within 25 ft. of the equipment.
   C. Because the equipment may need to be disconnected from power when being serviced, the receptacle is not permitted to be connected to the load side of the disconnect for the equipment. The receptacle for servicing the HVAC equipment must be GFCI protected per NEC.
      1. A GFCI protected outlet located within 25 ft. of the HVAC equipment will make it unnecessary for the servicing technician to use an extension cord that could be plugged into an outlet without GFCI protection.

PART 3: EXECUTION

3.01 DEMOLITION
   A. Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe or duct is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the user agency to minimize disruption to the existing building occupants.
B. All pipe, wiring and associated conduit, insulation, ductwork, and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor. All piping and ductwork specialties are to be removed from the site by the Contractor unless they are dismantled and removed or stored by the user agency. All designated equipment is to be turned over to the user agency for their use at a place and time so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.

3.02 INSTALLATION - GENERAL

A. Piping, ducts and similar items are shown on Project Drawings in approximate position desired; do not scale.

B. Determine exact location at Project Site by preliminary layout of systems (electrical, mechanical, sprinkler, structural, ceiling space, etc.) and resolve all conflicts prior to fabrication and/or ordering of materials.

C. Install exposed piping parallel to building lines, at uniform grade and at sufficient distance from walls to allow proper connections to risers and drops.

D. Close openings and open ends of all piping and ductwork during construction to exclude dust, debris and vandalism.

E. Sealing and Fire Stopping

1. FIRE AND/OR SMOKE RATED PENETRATIONS:
   a) Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 “Fire Stopping”.

2. NON-RATED PENETRATIONS:
   a) Pipe Penetrations:
      1) At pipe penetrations of non-rated interior walls, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood walls where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.
      (a) At all interior walls and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked. Pipe penetrations in exposed locations shall require escutcheon for finished appearance.

   b) Duct Penetrations:
      1) Annular space between duct (with or without insulation) and the non-rated walls or floor opening shall not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be patched to match existing construction to within 2" around the duct. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.
      (a) Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include laboratories, clean rooms, animal rooms, kitchens, cart wash rooms, janitor closets, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, where ducts are exposed and where noted on drawings elsewhere.
F. No piping shall be permitted to be installed in, enter or pass through dedicated electrical spaces for electrical switchboards, panelboards, distribution boards, etc. Dedicated electrical spaces extend from floor to structural ceiling with a width and depth that of the electrical equipment. No piping shall be permitted to be installed in, enter or pass through dedicated working spaces in front of electrical switchboards, panelboards, distribution boards, etc. Dedicated working spaces match the equipment width but not less than 30”, a depth of 36” and a height to at least 78” above floor. (Sections 110-16 through 110-26 and 384-4 of NFPA 70.)

G. Where piping penetrates concrete/masonry walls and/or floors, protect piping from physical damage and corrosion by using protective tape material or pipe insulation to prevent physical contact with concrete/masonry, mortar, etc.

H. Core drill openings in existing floor/wall, as required. Size of openings shall not exceed 1” larger than the O.D. of the piping penetrating the assembly. Coordinate with draft/fire stopping requirements.

3.03 EQUIPMENT SUPPLIERS’ INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Chillers
2. Variable Frequency Drives

B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner’s Operation and Maintenance Manuals.

3.04 EQUIPMENT START-UP

A. Equipment start-up shall not be used for temporary heating and cooling purposes without the consent of the Architect/Engineer.

3.05 ADJUSTMENTS

A. Adjust all specialty items, dampers and controls to normal operating position.

B. Commissioning Contract by Owner.

C. Start and operate all mechanical equipment and systems prior to occupancy by Owner.

D. Lubricate all motors, bearing and similar items, prior to completion of project and before operating equipment.

E. All motor belt drives shall be checked for proper alignment, belt tension and fan RPM.

F. All mechanical couplings shall be checked for alignment.

G. Pressure Vessels: Pressure relief valves on equipment shall be checked for setting and accuracy. Raise pressure on system to cause operation of relief valves.

3.06 ACCESSIBILITY

A. Access panels to valves, dampers, controls and equipment in walls or above inaccessible ceilings, will normally be indicated on Architectural Drawings.

B. Provide access to all concealed mechanical equipment or accessories requiring same, not indicated on Architectural Drawings.
C. Size of access panels shall be larger than the devices requiring access, but shall be not less than 6" square for wall panels and not less than 12" square for ceiling panels. Where the openings must allow adequate room for a person to pass through, a 24" x 24" panel shall be provided.

D. Construction of access panels shall comply with Specification Section 08310 Access Doors and Panels.

3.07 CLEAN-UP
A. Remove all dust, plaster and construction debris from ductwork, piping, fixtures and equipment prior to painting or occupancy by Owner.
B. Touch-up paint on all mechanical equipment that has rusted or has had finish marred during construction. Replace if satisfactory repair cannot be made.
C. Pipe system cleansing, sterilizing and other cleaning is specified in appropriate Sections of this Division.

3.08 UTILITY REBATES
A. This Contractor shall secure on behalf of the Owner all utility rebates associated with the design. This shall include all submittals to the utility companies including substantiation where required and making all necessary arrangements on behalf of the Owner.

3.09 MAINTENANCE DATA AND OPERATING INSTRUCTIONS
A. Deliver to the Owner, through the Architect/Engineer maintenance data and operating instructions. Assemble material in three-ring binders, using an index at the front of each volume and tabs for each specification section number involved. In addition to the data indicated in the General Requirements, include the following information:
   1. Copies of all approved shop drawings.
   2. Manufacturer's wiring diagrams for electrically powered equipment.
   3. Records of tests performed to certify compliance with system requirements.
   4. Certificates of inspection by regulatory agencies.
   5. Parts lists for equipment, valves and specialties.
   6. Manufacturer’s installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
   7. Valve schedules.
   8. Lubrication instructions, including list/frequency of lubrication.
   10. Equipment Startup Reports.
   11. Test and Balance Reports.
   12. Sub-contractor names, addresses, and telephone numbers.
   13. Additional information as indicated in the technical specification sections.
   14. Separate collective information by specification section and product. Group together in their respective sections and with the respective products.
B. Instruct and demonstrate to the Owner or his representative, the operation and servicing (normal maintenance) of all equipment and systems provided.
C. Operation and maintenance manuals shall be compiled, organized and submitted for each building.

END OF SECTION 23 05 00
SECTION 23 05 13  
MOTORS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS

A. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.

1.03 PRODUCT CRITERIA

A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.

B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.

C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

PART 2: PRODUCTS

2.01 THREE PHASE, SINGLE SPEED MOTORS

A. Use NEMA rated 480 volt, three phase, 60 hertz motors for all motors 1/2 HP and larger unless specifically indicated.

B. Use NEMA general purpose, continuous duty, Design B, normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections.

C. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

D. All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.

E. All motors 1 HP and larger shall meet or exceed requirements of ASHRAE 90.1-2013.

F. All motors 1-1/2 HP and larger shall meet or exceed local utility requirements for high efficiency motors. Mechanical Contractor shall verify current requirements with utility.
G. All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be high efficiency design with full load efficiencies which meet or exceed the values listed below when tested in accordance with NEMA Standard MG1-12.53a and MG1-12.53b. Motor efficiencies listed below are nominal. Minimum motor efficiencies shall not be less than the minimum efficiency as listed in Wisconsin Administrative Code, ILHR Chapter 63, Table 63.32.

FULL LOAD NOMINAL MOTOR PREMIUM EFFICIENCY BY MOTOR SIZE AND SPEED

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<tr>
<th>MOTOR HP</th>
<th>3600 rpm Nominal Efficiency</th>
<th>3600 rpm Minimum Efficiency</th>
<th>1800 rpm Nominal Efficiency</th>
<th>1800 rpm Minimum Efficiency</th>
<th>1200 rpm Nominal Efficiency</th>
<th>1200 rpm Minimum Efficiency</th>
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----Totally Enclosed Fan-Cooled----

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2.02 SINGLE PHASE, SINGLE SPEED MOTORS

A. Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller. Include internal overloads.

B. Motors for fans that are 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may sheave adjustments for airflow balancing in lieu of varying motor speed.
   1. Exception:
      a. Motors installed in space conditioning equipment certified under Section 6.4.12 or motors covered by Tables 10.8.d or 10.8.e of the ASHRAE Standard 90.1-2010.

2.03 VARIABLE FREQUENCY DRIVE (VFD)

A. Based on product by Toshiba or Danfoss.
   1. No equal products by other manufacturers are acceptable.

B. The variable frequency drive shall be sized to meet the horsepower requirements of the air handling unit listed in the schedules on drawing. Sizing shall be by the motor full load nameplate amps and not by nominal horsepower.

C. Units shall be suitable for input power of electrical system as scheduled on the drawings ±10%, 3 phase, 60 Hertz nominal.

D. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.

E. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 6:1 turndown.

F. Additional performance capabilities to include the following:
   1. Ride through a momentary power outage of 15 cycles,
   2. Start into a rotating load without damage to drive components or motor,
   3. Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage
   4. Input power factor: Min 0.95 throughout the speed range
   5. Minimum efficiency: 95% at 100% speed, 85% at 50% speed

G. The unit shall be U.L. listed, solid state, microprocessor based with a pulse width modulated (PWM) output wave form (none others are acceptable).

H. The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT’s) shall be employed as the output switching device.
I. Shaft Grounding Rings
   1. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR’s Service Life: Designed to last for service life of motor. Product manufactured by AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, Inpro/Seal CDR or approved equal.
   2. Application Note: Motors up to 100 HP shall be provided with one shaft grounding ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the shaft grounding ring manufacturer’s recommendations.

J. High Frequency Bonding
   1. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal.
   2. Application Note: High-frequency grounding straps must be used to ensure the proper grounding of all inverter-driven induction motor frames.

K. The NEMA-1 enclosure shall be provided with a hinged door with a door-mounted disconnect which must be thrown to the “off” position to gain access. Include power on and drive fault pilot lights and speed, power and ammeter digital indication on panel face. Include input fuses if required for UL rating. Provide the necessary heat sinks required to allow the unit to operate at full load at an ambient temperature of 40 degrees C.

L. Manual/auto selector switch chooses operation from the door mounted speed potentiometer to the automatic speed operation from a remote signal. The VFD package shall include semiconductor rated input fuses to protect power components. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference. VFD’s mounted inside an air handling unit section shall have an external disconnect located on the outside of the access door.

M. VFD automatically restarts the inverter after it has shutoff due to power outage or power dig. There is a time delay built into the system to allow the fan to coast to a stop before the control restarts after power has returned to within specifications. This time delay will be 60 seconds.

N. Provide the following features: adjustable acceleration/deceleration time, minimum and maximum frequency selector switch. Provide a signal to drive the variable air volume boxes 100% open for safety reasons during periods of manual mode. Provide drive with an auxiliary set of run contacts.

O. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive equipment, etc., and shall not be affected by or from other devices on the AC power system. All VFD’s shall include input line reactors. The reactors shall mount in the same enclosure as the VFD and shall be wired and tested at the factory. The reactors shall be sized such that when all drives are operating at full speed and full load, the total voltage distortion shall be 5% or less as measured at the load side of the service transformer per IEEE 519-1981.
   1. Line reactor shall be a three phase inductor, iron core, 600V, Class H insulation, 115 degree C rise, copper windings with screw type terminal blocks.
P. Additional Control Features:
1. Illuminated display keypad
2. Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control
3. Analog input, selectable 0-10v or 4-20 mA, for automatic control from the temperature control system
4. Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjusted
5. Adjustable minimum and maximum speed settings for both automatic and manual modes of operation
6. Field adjustment of minimum and maximum output frequency
7. Two (2) sets of programmable form “C” contacts for remote indication of variable frequency drive condition. Note: default programming to be set for “Drive Run & Fault”.
8. External Fault indicator
9. One (1) input for a N.O. dry contact type input for remote start/stop
10. One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes, etc).
11. One (1) N.O. dry contact output for proving motor status. This output shall be programmed to detect belt or coupling break that would remove the load from the motor. The dry contact will open on loss of load or VFD being off.
12. PID control loop capable of VFD control from an external device connected to a VFD analog input.

Q. The VFD controller shall convert VFD information into protocol that will be compatible with Section 23 09 93, Building Automation System (BAS), supplied on the project. This output shall be through a serial interface port capable of two-way communication with the building BAS provided on this project. Final connection shall not require any additional intermediate gateway devices to provide throughput of data. The following data shall be provided at a minimum:
1. Fault condition
2. Speed
3. Amperage
4. Frequency
5. Voltage

R. Protection Features:
1. Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:
   a. Activation of any safety device;
   b. Instantaneous overcurrent and/or over voltage of output;
   c. Power line overvoltage and undervoltage protection;
   d. Phase loss;
   e. Single and three phase short circuiting;
   f. Ground faults;
   g. Control circuit malfunction;
   h. Overtemperature; and
   i. Output current over limit.

2. Provide the following additional protective features:
   a. Input transient overvoltage protection up to 3000 volts per ANSI 37.90A;
   b. DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and de-energizes the drive at a predetermined current level;
   c. Fusing for the control circuit transformer; and
   d. Grounded control chassis.
PART 3: EXECUTION

3.01 INSTALLATION

A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.

B. When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer’s recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.

C. When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

3.02 VARIABLE FREQUENCY DRIVE

A. Provide factory trained start-up and training session with Owner's personnel at Project Site.

B. The VFD H-O-A switch on the cabinet door shall act as disconnect. Electrical Contractor will wire VFD from a fuse or circuit breaker panel.

C. Shaft Grounding Rings (All Motors With Variable Frequency Drives)
   1. Shaft grounding rings (SGR) shall be factory installed inside the motors by the manufacturer wherever possible. SGR’s may be field installed by installing contractor subject to Engineer’s approval. Provide AEGIS SGR Colloidal Silver Shaft Coating, or approved equal, on shafts prior to rings installation, per SGR manufacturer’s recommendations, after first cleaning shafts.
   2. Install and test SGR’s in accordance with manufacturer’s recommendations. Install the SGR so that the aluminum frame maintains an even clearance around the shaft. Conductive microfibers shall be in full circumferential contact with conductive metal surface of the shaft. Do not use thread lock to secure the mounting screws as it may compromise the conductive path to ground. If thread lock is required, use a small amount of EP2400 AEGIS Conductive Epoxy, or approved equal, to secure the screws in place.
   3. Shafts shall be clean and free of any coatings, paint, or other nonconductive material (clean to bare metal). Depending upon the condition of the shaft, it may require using emery cloth or Scotch-Brite. If the shaft is visibly clean, a nonpetroleum based solvent may be used to remove any residue. Check the conductivity of the shaft using an ohm meter. Ohms test: Place the positive and negative meter leads on the shaft at a place where the microfibers will contact the shaft. Each motor will have a different reading but in general one should have a maximum reading of less than 2 ohms. If the reading is higher, clean the shaft again and retest.
   4. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter. Place one probe on metal frame of SGR and one probe on motor frame. Motor must be grounded to common earth ground with variable frequency drive according to applicable standards. Verify that SGR installations and test readings comply with SGR manufacturer’s requirements.
D. Shaft Grounding Rings (All Motors With Variable Frequency Drives)

1. Shaft grounding rings (SGR) shall be factory installed inside the motors by the manufacturer wherever possible. SGR’s may be field installed by installing contractor subject to Engineer’s approval. Provide AEGIS SGR Colloidal Silver Shaft Coating, or approved equal, on shafts prior to rings installation, per SGR manufacturer’s recommendations, after first cleaning shafts.

2. Install and test SGR’s in accordance with manufacturer’s recommendations. Install the SGR so that the aluminum frame maintains an even clearance around the shaft. Conductive microfibers shall be in full circumferential contact with conductive metal surface of the shaft. Do not use thread lock to secure the mounting screws as it may compromise the conductive path to ground. If thread lock is required, use a small amount of EP2400 AEGIS Conductive Epoxy, or approved equal, to secure the screws in place.

3. Shafts shall be clean and free of any coatings, paint, or other nonconductive material (clean to bare metal). Depending upon the condition of the shaft, it may require using emery cloth or Scotch-Brite. If the shaft is visibly clean, a nonpetroleum based solvent may be used to remove any residue. Check the conductivity of the shaft using an ohm meter. Ohms test: Place the positive and negative meter leads on the shaft at a place where the microfibers will contact the shaft. Each motor will have a different reading but in general one should have a maximum reading of less than 2 ohms. If the reading is higher, clean the shaft again and retest.

4. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter. Place one probe on metal frame of SGR and one probe on motor frame. Motor must be grounded to common earth ground with variable frequency drive according to applicable standards. Verify that SGR installations and test readings comply with SGR manufacturer’s requirements.

E. High Frequency Bonding (All Motors With Variable Frequency Drives)

1. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter.

3.03 WIRING

A. Refer to Equipment Schedules on Plans for appropriate motor horsepower required.

B. All VFD’s shall have a disconnect on the cabinet door.

END OF SECTION 23 05 13
SECTION 23 05 48
VIBRATION ISOLATION

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Furnish all labor, materials and equipment required for installation of noise and vibration isolation devices and systems as shown or scheduled and as specified in this Section of the Specifications.

B. The isolation materials manufacturer or equipment manufacturer shall be responsible for the proper selection of spring rates to accomplish the specified minimum static deflections, for all spring and pad type isolators, based on the weight distribution of equipment to be isolated and for the structural design of steel beam bases and concrete inertia bases, to support mechanical equipment scheduled to receive a supplementary base.

1.03 RELATED WORK

A. Equipment supports, Section 23 05 00.

B. Metal sleeves for pipe and conduit penetrations of walls and floors, Section 23 21 12.

C. Suspension rods and inserts for suspension of mechanical equipment, piping and ductwork, Sections 23 21 13 and 23 31 00.

D. Flexible duct connections, Section 23 31 00.

1.04 SUBMITTALS

A. Submit in accord with Section 01 30 00.

1. Descriptive product data describing all material furnished under Part 2 of this Section.

1.05 ISOLATION EQUIPMENT OPTION

A. The materials and systems specified in this section may be purchased from one vibration isolation materials manufacturer to assure single responsibility for the performance of all isolation materials used; or may be supplied with individual equipment, by equipment supplier, subject to the requirements of this Section.

PART 2: PRODUCTS

2.01 MATERIALS

A. Based on materials manufactured by Mason Industries, Inc.

1. Equal systems by Amber-Booth, Flexonics, Gustin Bacon, Kinetics, Mercer, Metra-Flex, Minnesota Flexible Connector, Twin City Hose, Vibro-Acoustics, Vibration Eliminator and Vibration Mountings are acceptable.
2.02 TYPE OF ISOLATION

A. Type A: Neoprene Mounts - Double deflection; minimum of 0.35” static deflection; all metal surfaces neoprene covered; friction pads at top and bottom; Mason Model ND or rails Type DNR.

B. Type B: Spring Mounts - Bare spring without housing; neoprene friction pads at base plate and supports leveling bolts; spring diameter not less than 80% of the compressed height of the spring at rated load; must have a minimum additional travel-to-solid equal to 50% of the rated deflection; Mason Industries Model SLFH.

C. Type C: Spring Mounts with Housing - As specified under Type B, but with housing including vertical limit stops; minimum clearance of 1/2” around retaining bolts and between housing and spring; exterior installations to be hot dipped galvanized; Mason Model SLR.

D. Type D: Spring/Neoprene Piping Hangers - A Steel spring and 0.3” deflection neoprene element in series; neoprene element shall be molded with a rod isolation bushing that passes through the hanger box; hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the hole and short circuiting the spring; springs shall have a minimum additional travel to solid equal to 50% of the rated deflection; Mason Model 30N or PC30N.

E. Type F: Spring/Neoprene Duct Hangers - A steel spring located in a neoprene cup with a grommet to prevent short circuiting of the hanger rod; hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the hole and short circuiting the spring; springs shall have a minimum additional travel to solid equal to 50% of the rated deflection; an eye bolt on the spring end to attach the housing to the flat iron duct straps; Mason Model W30.

F. Type K: Flexible Connectors - Nylon cord and neoprene, moulded; threaded ends through 2", floating flanges over 2”. Mason MFN elbows or MFT connections. Spherical flexible connectors with peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Outdoor units shall be EPDM. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer. Threaded ends through 2", floating flanges over 2". All connectors shall be rated for a minimum working pressure of 150 psi at 220°F.

G. Type L: Flexible Hoses - Stainless steel braid and carbon steel fittings, sizes 3" and larger - flanged, smaller sizes - male nipples; Mason Model BSS or BB (bronze), with copper.

H. Type M: Acoustic Seals - At walls, floors of ceiling, provide a slit seal to minimize the passage of noise through the seal and vibration to the structure, seal shall consist of two pipe halves with 3/4" or thicker neoprene sponge bonded to the inner faces; design shall include a bolting arrangement to fix the seal around the pipe and eliminate clearance between the inner sponge face and the piping; concrete can then be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe; seals shall project a minimum of 1” past either face of the wall; Mason Model SWS.

I. Type W: Neoprene Waffle Pads - For installation having light eccentric loading, requiring only minimum isolation. Pad shall have gripping surface on both top and bottom, with a steel plate sandwiched between when no anchor bolts will be required and shall be Mason Style WMW. Pads shall be Mason Style WML when leveling bolts are required.
PART 3: EXECUTION

3.01 INSTALLATION

A. Installation of vibration isolation materials and supplemental equipment bases specified in this Section of the specifications shall conform to the latest manufacturer's written instructions.

B. On completion of installation of isolation materials and before start-up of isolated equipment, all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.

C. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified.

D. Provide flexible connections between equipment and duct work connecting thereto.

E. Seal openings in walls, floors and ceilings at point piping or ductwork passes through; between rooms having noise generating equipment and quiet areas.

3.02 NOISE AND VIBRATION ISOLATION

A. Equipment:
   1. Unless otherwise indicated, mechanical equipment except roof exhausters, having motors 1 horsepower or larger, shall be isolated from the building structure by means of noise and vibration isolators.
   2. Refer to schedule at end of this Section and/or to "Equipment Vibration Isolation Schedule" on Drawings.
   3. Neoprene Waffle Pads:
      a. Install under WC-1 between equipment and concrete pad.

B. Piping:
   1. Piping 1-1/4 inch and larger, for a minimum distance of 30 feet or 3 pipe hangers from connection to vibration isolated mechanical equipment, shall be isolated from the building structure by means of noise and vibration isolation hangers, except that pumps and similar equipment provided with flexible hoses or Victaulic flexible couplings on vertical risers, will not require piping isolation hangers.
   2. Victaulic flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.

C. Ductwork:
   1. High pressure ductwork (2000 FPM velocity or higher), located in mechanical equipment rooms and for a distance of 30 feet from connection to vibration isolated air moving equipment, shall be isolated from building structure by means of noise and vibration isolation hangers.

D. Piping and ductwork to be isolated according to this Section of the specification, shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork, and maintain a minimum of 3/4" and maximum of 1-1/4" clearance around the outside surfaces. This clearance space shall be tightly packed with 1.58 P.C.F. fiberglass, and caulked airtight, after installation of piping or ductwork.

E. Flexible Connectors: Install at all air handling units requiring vibration isolation equipment herein specified, on all hot and chilled water piping.
   1. The following equipment shall have flexible connectors at all water connections thereto:
      a. CWP-1 & CWP-2
F. Electrical Isolation: Mechanical equipment, will have flexible electrical connections furnished and installed under Division 26, Electrical.

3.03 INSPECTION

A. Contractor shall notify the vibration isolation materials manufacturer prior to installing any vibration isolation devices and shall seek guidance in installation procedures.

B. On completion of installation, isolation materials manufacturer representative shall inspect the completed system, at request of Contractor or AE, should a problem occur.
DEFLECTION AND MOUNTING CRITERIA FOR 4” - 6" THICK SOLID CONCRETE FLOORS (See Note 6)

<table>
<thead>
<tr>
<th>Ground</th>
<th>20’ Floor Span</th>
<th>30’ Floor Span</th>
<th>40’ Floor Span</th>
<th>50’ Floor Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported Slab Or Basement</td>
<td>Possible Floor Defl</td>
<td>Possible Floor Defl</td>
<td>Possible Floor Defl</td>
<td>Possible Floor Defl</td>
</tr>
</tbody>
</table>

a. EQUIPMENT

REFRIGERATION MACHINES

Absorption Machines
Centrifugal Chillers or Heat Pumps
Cooler Condenser Mounted Hermetic-Compr.
Cooler Condenser Alongside Hermetic-Compr.
Open Type Compressors (Note 3)
Refrigeration Reciprocating Compressors
500 RPM to 750 RPM
751 RPM and Over
Reciprocating Chillers or Heat Pumps
500 RPM to 750 RPM
751 RPM and Over

PUMPS

Close Control
Thru 5 HP
7 1/2 HP and Larger
Base Mounted (Note 2)
Up to 60 HP
75 HP and Larger

FACTORY ASSEMBLED H & V UNITS

Curb Mounted Roof-Top Units
Suspended Units (For Fan Heads, See Note 7)
Thru 5 HP
7 1/2 HP and Larger - 275 RPM to 400 RPM
7 1/2 HP and Larger - 401 RPM and Over
Floor Mounted Units (For Fan Heads See Note 7)
Thru 5 HP
7 1/2 HP and Larger - 275 RPM to 400 RPM
7 1/2 HP to 40 HP - 401 RPM and Over
50 HP and Larger - 401 RPM and Over

19021 Western Apprenticeship Center Remodel
C. NOTES:

(1) Minimum deflection called for in this specification are not 'nominal' but certifiable minimums. The 0.75", 1.5", 2.5", 3.5", and 4.5" minimums should be selected from manufacturers nominal 1", 2", 3", 4", and 5" series respectively.

(2) Vacuum, Condensate or Boiler Feed Pumps shall be mounted with their tanks on a common J base with deflections as specified for base mounted pumps.

(3) The base described in Spec. G is used under the drive side. Individual mountings as described in Spec. C are used under the Cooler and Condenser.

(4) Limit deflection for utility sets (18" wheel diameter and smaller) to 1 1/2".

(5) Floating Concrete Inertia Bases, do not reduce vibration transmitted to the structure through the mountings. These bases will reduce vibratory motion, provide a very rigid machine base and minimize spring reactions to fan thrust.

(6) Light Floor Construction: When floors are lighter than the 4" concrete or the location is in a particularly sensitive area, select deflection requirements for the next larger span.

(7) If units are fan head sections only, change designations to D-X for suspension and AX or BX for floor mountings. Refer to "Blower Minimum Deflection Guide" to select deflections.

END OF SECTION 23 05 48
SECTION 23 05 53
IDENTIFICATION: PIPES/VALVES/DUCTWORK

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Tag new valves with reference to listing.

B. Identify all new mechanical piping and ductwork as hereinafter specified under "EXECUTION".

1.03 RELATED WORK

A. Piping: Section 23 21 10.

B. Valves: Section 23 21 11.

C. Ductwork: Section 23 31 00.

D. Painting of Piping and Ductwork: Division 9.

1.04 SUBMITTALS

A. Submit in accord with Section 01 30 00.
   1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.
   2. Submit valve chart, on form provided at end of this Section.

PART 2: PRODUCTS

2.01 VALVES

A. Provide round sheet aluminum, brass or plastic tags with brass or galvanized steel split ring or S rings. Tags shall have identification number stamped on and prefixed "H" for heating and "C" for cooling.

2.02 PRINTED CHARTS

A. Glazed (black) wood or metal frame, with typed chart indicating valve number, manufacturer, model number, location, system used, function, etc. See attached form.

2.03 IDENTIFICATION-PIPE MARKERS (OPTIONAL)

A. Based on product by Seton Nameplate Corporation.
   1. Brady, Emed Co., Ready Made or MIFAB equals are acceptable.
B. Seton "Set Mark" type SNA markers shall be used on piping/insulation with overall outside diameters 3/4 inch through 5 inch; Type STR markers shall be used on piping 6 inch diameter and larger. Include flow direction arrows, as scheduled.
   1. Markers to be semi-rigid plastic designed to fit over piping and Snap-on tight. Furnish as per manufacturers recommendations, color coded as per ANSI Specifications.

2.04 EQUIPMENT IDENTIFICATION

A. Based on product by Seton Nameplate Corp.

B. Mechanical equipment shall have plastic identification plates engraved on 1/8 inch thick, white core, black surface. Attach with pressure-sensitive tape or screw to equipment.
   1. Nameplates to be 6" x 12" size for major equipment and proportionally smaller for other equipment.
   2. Wording on nameplates shall identify the equipment, corresponding to markings on drawings, schedules or specification.

PART 3: EXECUTION

3.01 VALVES

A. Attach tags for valve identification, with split ring around valve stem. Attach chart to wall with screws or bolts.

B. Place color-coded ¼" round self-adhesive dot/sticker on ceiling tile grid at each valve location. Dot/sticker shall be placed on the edge of the grid closest to the tile to be removed for valve access.

3.02 IDENTIFICATION: PIPE AND DUCT

A. Finish painting for all piping, ductwork, covering, hangers and equipment furnished under the Mechanical Work, is included under Division 9, Painting, unless otherwise stated herein.

B. After painting is completed, stamp or stencil all exposed piping and ductwork in equipment rooms, boiler and furnace rooms, accessible pipe spaces, unfinished storerooms, pipe tunnels and concealed piping above suspended ceilings, as follows:
   1. Stenciling shall be black and done on side or bottom of pipe covering, uncovered pipe or duct, as required to be easily seen and read.
   2. Stenciling shall be black and done on side or bottom of pipe as required to be easily seen and read.
   3. Stencil at intervals of 15 feet, but at least once in every room, including alongside each valve.
   4. Conform to the following schedule:
      a. O.D. of PIPE or COVERING HEIGHT of LETTERS
         1) Thru 1-1/4 inch 1/2 inch
         2) 1-1/2 inch to 3 inch 1 inch
         3) 4 inch and over 1-1/2 inch
   5. Stencil wording shall be as follows:
      a. WELL WATER (*)
      b. WELL WATER DISCHARGE (*)
      c. HEATING SUPPLY (*)
      d. HEATING RETURN (*)
      e. HEATING PUMP DISCHARGE (*)
f. CHILLED WATER SUPPLY (*)
g. CHILLED WATER RETURN (*)
h. CONDENSER WATER SUPPLY (*)
i. CONDENSER WATER RETURN (*)

6. (*) Add flow direction arrow to these designations.

C. Unpainted covered piping shall be given a coat of clear seal under area of stencil, before application.

D. Install Seton identification pipe markers as recommended by manufacturer.

3.03 EQUIPMENT IDENTIFICATION

A. Mechanical equipment (hereafter indicated), shall have plastic identification plates installed as recommended by manufacturer. Attach with pressure-sensitive tape or screw to equipment.

B. Identify the following HVC equipment:
   1. VAV Boxes.
   2. Rooftop Units.

END OF SECTION 23 05 53
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PART 1: GENERAL

1.01 RELATED DOCUMENTS
A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED
A. Piping will have openings capped and shall be tested before any painting, covering or backfilling is done.
   1. Testing shall be conducted in the presence of the Owner's representative, the Architect, the Engineer, inspector or their representatives. Contractor shall notify AE of proposed tests at least two days prior to testing.
   2. When plumbing systems are installed in a municipality having a local inspector, the inspector shall:
      a. Inspect system testing.
      b. Inspect rough-in work before being closed in, concealed, covered and fixtures set.
      c. Inspect final installation.
      d. Notify the inspector when work is ready for inspection.
      e. Provide apparatus and appliances required for making the tests.
      f. If inspector fails to inspect by the end of the following business day, contractor may proceed with work.
   3. Respective piping Trade shall provide all equipment required to conduct tests.
   4. Submit report on test results, on form provided at end of this Section. Include this form (or similar) in the O&M manuals.

PART 2: PRODUCTS - NOT USED

PART 3: EXECUTION

3.01 TESTING

A. Piping systems shall be tested as hereafter specified; but not less than 50% above the operating pressure of the system.

B. Piping systems test requirements:

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEST</th>
<th>PRESSURE</th>
<th>HOLD</th>
<th>PERMISSIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Victaulic</td>
<td>Hydrostatic</td>
<td>100 PSIG</td>
<td>4 Hrs.</td>
<td>2 PSI</td>
</tr>
<tr>
<td>2. Hot Water Heating</td>
<td>Hydrostatic</td>
<td>100 PSIG</td>
<td>4 Hrs.</td>
<td>2 PSI</td>
</tr>
</tbody>
</table>

C. Defects discovered during the tests shall be immediately corrected and piping system shall be retested until it qualifies. Defective joints found in welded piping shall be ground off and rewelded; screwed joints shall be disassembled, cleaned and rejoined as a new joint.

END OF SECTION 23 05 92
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PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS

A. Submit in accord with Section 01 30 00.
   1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.

1.03 SCOPE

A. Provide balancing on the below systems:
   1. Hot water system
      a. Complete water balancing on hot water system. This includes 1 existing air handling units and associated VAV/radiation that need to be water balanced to the flows listed on the drawings.
   2. RTU
      a. Complete air and water balancing of rooftop unit system. Air balancing shall be done at just RTU level and zone level VAV boxes.

PART 2: PRODUCTS

2.01 SERVICE FIRMS

A. Services by Balance Technologies, Environmental Systems Analysis, Mechanical Data Corporation, MFB, T&B Services and WHV are acceptable.

Balance Technologies: Willie Kerlin, 10400 N. Baehr Road, P.O. Box 428, Mequon, WI 53092
Environmental Systems Analysis, 4262 Argosy Court, Madison, WI 53714
Mechanical Data Corporation: 18305 Minnetonka Boulevard, Wayzata, MN
MFB, Dan Boisen, 2920 East Avenue South #102, La Crosse, Wisconsin 54603
T&B Services, 110 B E. Grand Avenue, Eau Claire, WI 54701
WHV, Joel VonHaden, 324 East Second Street, Winona, Minnesota 55987

B. Contractor shall be NEBB or A.A.B.C. certified and specialize in balancing field. Contractor shall provide all labor, engineering, test equipment, ladders and scaffolding required. All personnel involved in the execution of the work shall be experienced and factory trained in the total balancing of mechanical systems, as well as being regular employees of the balancer.

2.02 SERVICE

A. Test equipment furnished by the Contractor will remain his property. All instruments will have been calibrated recently verification of calibration provided with submittal data.

B. Contractor will balance to the values established by the Drawings and Specifications.
C. For hydronic systems, the balancing fittings (stations) will be furnished and installed in piping under Section 23 21 16.

D. Balancing shall not begin until the systems have been completed, cleaned and are in full working order.

E. Check that all equipment is operating properly and lubricated.

F. Balancer shall coordinate and work with the Temperature Control installer, (Section 23 09 93) in establishing system operating conditions.

PART 3: EXECUTION

3.01 TEST AND BALANCING PROCEDURE FOR AIR

A. Determine that all air handling systems are free of obstructions; start with all dampers and grilles fully open. Check that filters are installed and clean.

B. Measure supply air volumes by means of duct traverse method, taking a minimum of sixteen (16) readings. Seal duct access holes with plastic or metal snap-in plugs. The use of duct tape to seal access holes will not be permitted.

C. Adjust balancing dampers for required branch duct air quantities.

D. Adjust grilles and diffusers to within minus 5% to plus 10% of individual requirements specified for air quantities greater than 300 CFM and zero to plus 15% for air quantities less than 300 CFM. Adjust to minimize drafts in all areas.

E. Total air delivery in any particular fan system shall be obtained by adjustment of the fan speed. The drive motor of each fan shall not be loaded over the corrected full load amperage rating of the motor involved.

F. Duct leakage tests: Test and verify conditions for supply air systems only, AH-1. Leakage shall not exceed 5% for systems up to 1800 FPM (low pressure) and 1% for systems over 1800 FPM (medium/high pressure). Ductwork shall be tested before any outlets are connected or any exterior insulation is installed. Test a sample section of ductwork as agreed upon with owner & A/E. Once acceptable ductwork construction standards are validated, then no further testing is required. Open ends of all ducts shall be sealed under Section 23 31 00, including connection to air handling unit. Conform to SMACNA and ASHRAE test procedures. Include testing data reports in O&M manuals.

3.02 TEST AND BALANCING PROCEDURE FOR WATER

A. Before setting pump capacities, check the following items:
   1. Automatic fill valve setting and strainer.
   2. Expansion tank level.
   3. Cleanliness of system water.
   4. Make certain all pump strainers are clean.
   5. Check air vents at coils and high points of system.

B. Measure circulating pump capacities by differential pressure measurements, amperage and brake horsepower method using the pump manufacturer's capacity curve. Position all automatic valves, hand valves and balancing cocks for full flow through coils, converters, etc. during pump adjustment. Use only calibrated test gages for pump adjustment; the use of pressure gages installed with the system will not be allowed.
C. Coordinate the setting of controls to maintain coil water inlet design temperatures, with coil valves positioned for full flow through coil during adjustment. Balance individual water coils at full flow to maintain temperature differential specified.

D. Mark settings of all balancing cocks at required positions.

E. Furnish all meters required to balance flow using balancing fittings (stations) installed in piping, under Section 23 21 16.

F. Record all information as hereinafter specified.

3.03 CHANGES/ADJUSTMENTS

A. Any changes that are required for the final balancing results shall be provided for by the respective Contractors who supply and install the equipment, except changing of pulleys, belts and providing additional access holes, which shall be done under this Section, at no additional cost to the Owner.

3.04 BALANCING DATA

A. System report shall include the following information:

1. Fans:
   a. Manufacturer, size and H.P.
   b. Amperage (nameplate, corrected full load and final operating).
   c. Motor current characteristics, starter size, heater size.
   d. Fan RPM (design and final operating); maximum and minimum for VAV.
   e. Brake horsepower.
   f. Fan CFM (design and final operating).
   g. Fan suction, discharge and total static pressure (design and final operating).
   h. Method by which CFM was determined.
   i. VFD speed

2. System external to fan - test data:
   a. Grille or diffuser reference number and manufacturer.
   b. Location.
   c. Design velocity and CFM.
   d. Flow factor.
   e. Final conditions of balance.
   f. Method used to determine air quantities.

3. Variable air volume units:
   a. Manufacturer’s name and size.
   b. Location and tag number.
   c. Design velocity and CFM.
   d. Final conditions of balance (maximum and minimum).
   e. Method used to determine air quantities.
   f. Record inlet ring pressure differential at maximum air flow.

4. Pumps:
   a. Manufacturer, size and H.P.
   b. Amperage (nameplate, corrected full load and final operating).
   c. Motor current characteristics, starter size, heater size.
   d. Pump RPM (design and final operating).
   e. Brake horsepower.
   f. GPM (design and final operating).
   g. Pump discharge and suction pressures.
   h. Method by which GPM was determined.
   i. VFD speed
5. System external to pump - test date:
   a. Design velocity and GPM.
   b. Flow factor.
   c. Final conditions of balance.
   d. Method used to determine water quantities.

6. Heating and/or cooling coils:
   a. Coil type and manufacturer.
   b. Entering and leaving air temperature (D.B.) heating and cooling coils (design and final).
   c. Entering and leaving air temperature (W.B.) cooling coil (design and final).
   d. Entering and leaving chilled water temperature (design and final).
   e. Velocity across coil.
   f. Static pressure drop across coil.

7. Outdoor air/return air/relief air dampers:
   a. Establish minimum positions for occupancy periods.
   b. Record final conditions and method of determination.
   c. Traverse outdoor air duct for minimum and maximum CFM.
   d. Adjust counter-balanced backdraft dampers at relief hoods to prevent exterior doors from standing open during economizer cycle. Initially set at 0.05” static pressure differential.

3.05 FINAL ADJUSTMENT
   
   A. The Contractor shall work with other Trades, after initial balancing is completed, in an effort to resolve any air or water quantity shortage or other problems apparent after review of data.
   B. Determine cause of problem and suggest remedy.
   C. Should remedial action be required, continue balancing only after corrective action is completed.
   D. Do not submit balancing report until all air volume or GPM water flows measured are within design percentages as noted above.
   E. Reinstall all insulating covers on pipe balancing stations.
   F. Include duct leakage test results with air balance report.
   G. Create an isometric of each air handling unit showing static pressures:
      1. Across dampers.
      2. Across flow measuring station.
      3. Across filters.
      4. Across heating coil.
      5. Across cooling coil.
      6. Across supply fan.
   
   H. Submittal must be bound in a plastic cover or three-ring binder.

END OF SECTION 23 05 93
SECTION 23 07 00 – HVAC SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Project drawings, related applicable specification sections, and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.3 MECHANICAL CONTRACTOR COSTS

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning tasks and commissioning agent assistance are to be included in each contractors cost.

B. Contractors shall include costs in their bid amount to provide commissioning assistance (per the specified contractors responsibilities and execution sections below) via a contractor supplied skilled senior technician / journeyman for the following:

   1. Western Technical College
      a. Ventilation Contractor: 4 labor hours
      b. Piping Contractor: 4 labor hours
      c. Controls Contractor: 16 labor hours
      d. TAB Contractor: 4 labor hours

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests and equipment function tests at the direction of the Commissioning Agent (CxA).

B. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

C. Provide information requested by the CxA for final commissioning documentation.

D. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.5 COMMISSIONING AGENT'S (CxA) RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Commissioning testing.

C. Verify testing, adjusting, and balancing of work are complete.

D. Provide test data, inspection reports, and certificates in systems manual.
1.6  COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Submittals, systems manuals, operation and maintenance manuals.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Schedule for completing construction checklists and manufacturer's pre-start and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Verification of testing, adjusting, and balancing reports.
   8. Review of operation and maintenance manuals.

1.7  SUBMITTALS

A. Copy of all equipment submittals.
B. Operation and Maintenance Manuals.
C. Certificates of completion of installation, pre-start, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1  COMPONENTS TO BE COMMISSIONED

A. The following equipment and systems, at a minimum, will be tested and commissioned to assure installation and function per the design documents and design intent.
   1. Equipment will be cycled through the specified controls sequences and critical controls points will be verified.
   2. Equipment will be turned on and off to assure function.
   3. Discharge temperatures will be verified.
   4. Valve and damper cycling will be verified.
   5. Outdoor airflow rates will be verified.

B. Heating and Cooling Systems
   1. Hydronic Coils
   2. Glycol Concentrations in Cooling Water Piping Systems
   3. Controls Systems for the Chilled Water Systems

C. Ventilation Systems
   1. Air Handling Unit

D. Plumbing Systems
   1. Non-Potable Well
3.2 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.3 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide sample copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 7 days in advance of testing and balancing Work, and provide access for the CxA to witness critical portions of the testing and balancing Work.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. HVAC Instrumentation and Control System Testing: Assist the CxA with preparation of testing plans.

B. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in piping Sections. HVAC Contractors shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating final reports to the CxA.

C. HVAC Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC terminal equipment and unitary equipment.

END OF SECTION 23 07 00
PART 1: GENERAL

1.01 RELATED DOCUMENTS
   A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
   B. The requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED
   A. Applies to all mechanical systems ductwork, as hereinafter specified.

1.03 RELATED WORK
   A. Ductwork: Section 23 31 00.
   B. Insulated Flexible Duct: Section 23 31 00.

1.04 REFERENCE STANDARDS
   A. MICA Midwest Insulation Contractors Association, www.micainsulation.com
      National Commercial & Industrial Insulation Standards

1.05 SUBMITTALS
   A. Submit in accord with Section 01 30 00.
      1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.
      2. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.
      3. Submit a drawing or MICA Plate describing how the insulation will be installed.

PART 2: PRODUCTS

2.01 DUCT INSULATION
   A. Based on product by Johns Manville.
      1. Armstrong Company, Certainteed, Manson, Knauf or Owens-Corning equals are acceptable.
      2. All insulation and liner components shall have composite fire and smoke hazard ratings meeting NFPA 90-A and 90-B, Flame Spread 25 and Smoke Developed 50.
   B. TYPE W1: Fiberglass Blanket w/ FSK vapor barrier.
      1. "Microlite" FSK fiberglass blanket, with vapor barrier facing, adhered to duct exterior with Benj. Fosters #85-15 adhesive, with joints lapped and sealed for complete vapor barrier.
      2. Ductwork including round, shall be additionally secured at bottom with mechanical fasteners, 15 inches o.c.
3. Thermal conductivity: Type 75 = R-5.2/K-0.29; Type 100 = R-5.6/K-0.27, Type 150 = R-6.0/K-0.25 at 75 degrees F. mean temperature and 1-1/2 inch thickness "out of package". Rated for service to 250 degrees F. maximum.
   a) Installed R-values @ 1-1/2 inch thickness are: Type 75 = R-4.2; Type 100 = R-4.5; Type 150 = R-4.7

C. TYPE W2: Fiberglass Blanket.
   1. "Microlite FSK" fiberglass blanket, faced, adhered to duct exterior with Benj. Fosters #85-15 adhesive, with joints lapped and sealed for complete vapor barrier.
   2. Ductwork including round, shall be additionally secured at bottom, with mechanical fasteners, 15 inches o.c.
   3. Thermal conductivity: Type 75 = R-5.2/K-0.29; Type 100 = R-5.6/K-0.27, Type 150 = R-6.0/K-0.25 at 75 degrees F. mean temperature and 1-1/2 inch thickness "out of package". Rated for service to 250 degrees F. maximum.
      a) Installed R-values @ 1-1/2 inch thickness are: Type 75 = R-4.2; Type 100 = R-4.5; Type 150 = R-4.7

D. TYPE W3: Fiberglass Board w/ FSK vapor barrier.
   1. "Spin-Glas" FSK, Type 814 3# density (minimum) fiberglass board with factory applied FSK vapor barrier finish jacket. Cut to fit between and over all stiffeners and standing seams. Kirfed type corners will be made where possible.
      a) Joints to be tightly butt and sealed with pressure sensitive smooth aluminum tape.
      b) Secure by impaling over mechanical fasteners, not over 18 inches on center.
   2. Over entire exposed duct surface apply two wet coats of white lagging adhesive, Foster's 30-36, reinforced with 20-20 glass mesh, lapping 2 inches for the following ductwork:
      a) Ductwork within 8’ of floor, catwalks and mezzanines in mechanical rooms
   3. Thermal conductivity: R = 4.35 / K = 0.23 at 75 degrees F. mean temperature and 1 inch thickness.
      a) K=0.25 at 125 degrees F, K=0.27 at 150 degrees F, K=0.29 at 200 degrees F, K=0.32 at 250 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

E. TYPE W4: Semi-Rigid Fiberglass w/ white AP jacket.
   1. "Micro-Flex" semi-rigid fiberglass insulation, with "AP" all-purpose white factory-applied jacket; maximum temperature, +850°F. Apply with joints tightly butt and sealed.
   2. Joints to be tightly butt and sealed with pressure sensitive smooth tape.
      a) Compressive Resistance 25, Density 2.5 pcf.
      b) Adhere with Benj. Foster's 81-91 adhesive, covering at least 50% of surface; seal joints with 3" wide strip of "AP" covering.
   3. Thermal conductivity: R = 4.5 / K = 0.24 at 75°F. mean temperature and one inch thickness

F. TYPE W5: Fiberglass Board w/ ASJ vapor barrier jacket.
   1. "Spin-Glas" AP, Type 814 3# density (minimum) fiberglass board with factory applied ASJ vapor barrier finish jacket. Cut to fit between and over all stiffeners and standing seams. Kirfed type corners will be made where possible.
      a) Joints to be tightly butt and sealed with pressure sensitive smooth tape.
      b) Secure by impaling over mechanical fasteners, not over 18 inches on center.
2. Thermal conductivity: \( R = 4.35 / K = 0.23 \) at 75 degrees F. mean temperature and 1 inch thickness.
   a) \( K = 0.25 \) at 125 degrees F, \( K = 0.27 \) at 150 degrees F, \( K = 0.29 \) at 200 degrees F, \( K = 0.32 \) at 250 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

G. TYPE W6: Polyisocyanurate Flat & Tapered Foam Board w/ Glass mat facer on both sides.
   1. Flat and tapered roof insulation consists of a closed-cell polyiso foam core laminated to a black glass reinforced mat facer on both major surfaces.
   2. To create a water resistive barrier or an air barrier, treat seams and penetrations as instructed in by the manufacturer.
   3. Thermal resistivity: \( R = 6.0 \) per inch at 75 degrees F. mean temperature aged 180 days.
   4. Minimum nominal density of 2.0 lbs. per cu. ft., minimum compressive strength of 20 psi, maximum water vapor permeability of <1 perm, maximum water absorption of <1% by volume, rated for service range of -100 degrees F to 250 degrees F.
   5. Joints to be covered with an insulation jacketing tape as manufactured by VentureTape or equal. Tape product shall be multilayered laminate coated with an aggressive cold weather acrylic pressure sensitive adhesive that has excellent low temperature performance. Product is designed for use as a zero permeability vapor barrier and has superior resistance to weathering, mold, UV and extreme environmental conditions. The product is also UL listed.

H. TYPE W6a: Pre-insulated outdoor duct system.
   1. Pre-insulated outdoor duct system. See Specifications Section 23 31 00.

I. TYPE W7: Polyisocyanurate Foam Board w/ foil facer on both sides.
   1. “AP Foil-Faced” polyisocyanurate foam sheathing with factory applied water-resistant, vapor and air barrier finish jacket.
   2. Insulation board consists of a uniform closed-cell polyisocyanurate foam core bonded on each side to a foil facer.
   3. To create a water resistive barrier or an air barrier, treat seams and penetrations as instructed in by the manufacturer.
   4. Thermal resistivity: \( R = 6.0 \) per inch at 75 degrees F. mean temperature aged 180 days.
   5. Minimum nominal density of 2.0 lbs. per cu. ft., minimum compressive strength of 16 psi and 40 psi flexural strength, maximum water vapor permeability of 0.1 perm, maximum water absorption of 0.5% by volume, rated for service range of -100 degrees F to 250 degrees F.
   6. Joints to be covered with an insulation jacketing tape as manufactured by VentureTape or equal. Tape product shall be multilayered laminate coated with an aggressive cold weather acrylic pressure sensitive adhesive that has excellent low temperature performance. Product is designed for use as a zero permeability vapor barrier and has superior resistance to weathering, mold, UV and extreme environmental conditions. The product is also UL listed.

2.02 ADHESIVES AND MASTICS

A. Adhesives, Mastic, Sealants, and Reinforcing Materials
   1. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
2. Fiberglass Insulation Adhesive:
   a) Must comply with ASTM C916, Type II: Foster 85-60, Childers CP-127, Duro Dyne SSG.

3. Vapor Retarding Mastic:
   a) Below ambient equipment/piping, mastic must be anti-fungal and shall meet ASTM D 5590 with 0 growth rating (AF), water vapor permeance shall be less than 0.013 perms at 43 mils dry film thickness per ASTM E 96 Procedure B: Foster 30-80AF Vapor Safe Mastic or equal.

4. Lagging Adhesive / Coatings:
   a) For all indoor applications, coating must be anti-fungal and shall meet ASTM D 5590 with 0 growth rating (AF): Foster 30-36 AF Seal Fas, Childers CP-137 AF Chil-Seal.
   b) Fibrous glass or canvas fabric reinforcing used with lagging adhesive shall have a minimum untreated weight of 6 oz./sq. yd.
   c) Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

5. Reinforcing Mesh:
   a) Foster 42-24 Mast A Fab, Childers Chil Glas #10 or Pittsburgh Corning PC 79.

2.03 DUCT LINERS
A. TYPE L1: Glass Fiber, Indoors (6000 FPM Maximum):
   1. "Linacoustic RC", 1-1/2# density flexible glass fiber duct liner, with black matt fire resistant coating to air stream. ASTM C 1071.
   2. Adhere to all inside surfaces of duct using fire resistant 3M bonding adhesive; all joints to be butt tight and sealed. Install liner using adhesive conforming to ASTM C 916.
   4. Thermal conductivity: \( R = 4.2/K = 0.24 \) at 75 degrees F. mean temperature and 1 inch thickness.
   5. ASTM E84 flame spread less than 25 and smoke developed less than 50.
   6. Acoustical performance, 125Hz = 0.08, 250Hz = 0.31, 500Hz = 0.64, 1000Hz = 0.84, 2000Hz = 0.97, 4000Hz = 1.03, Noise Reduction Coefficient (NRC) = 0.70 per ASTM C 423

B. TYPE L2: Elastomeric Acoustical Liner:
   1. Mold resistant black closed cell elastomeric self-adhering thermal insulation. Formaldehyde-free, fiber free, low VOC, Microban, GREENGUARD Certified.
   2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
   3. Armacell AP Armaflex SA Black Duct Liner. K-value of 0.25 at 75 deg. F. Performance at 1” thickness, R-value of 4.0
   4. Acoustical performance, 125Hz = 0.05, 250Hz = 0.17, 500Hz = 0.08, 1000Hz = 0.44, 2000Hz = 0.60, 4000Hz = 0.49, Noise Reduction Coefficient (NRC) = 0.50.

2.04 PRE-INSULATED OUTDOOR DUCT SYSTEMS
A. See Specifications Section 23 31 00 system description.
2.05 OUTDOOR INSULATION JACKETS

A. Self-adhesive Multi-ply.

B. Self-healing Rubberized Bitumen.
      • Use activator if required for low temperature installations.
      • Provide one-way air pressure release valve on ductwork under positive pressure.
      • Do not paint ductwork.

PART 3: EXECUTION

3.01 DUCT INSULATION AND LINERS

A. Duct sizes indicated on plan are inside free area required and must be increased the insulation thickness, if liners are used.

B. Insulation shall be installed as per manufacturer’s recommendations by a qualified insulation subcontractor.

C. Duct Liner Installation:
   1. Install liner in compliance with the latest edition of NAIMA’s Fibrous Glass Duct Liner Standard. Locate longitudinal joints at the corners of duct only. Cut and fit to assure lapped, compressed joints. Coat all transverse and longitudinal joints and edges with adhesive. Provide metal nosing on leading edge where lined duct is preceded by unlined duct. Adhere liner to duct with full coverage area of adhesive. Additionally secure liner to duct using mechanical fasteners spaced as recommended by the liner manufacturer without compressing liner more than 1/8” with the fasteners.

D. Insulation and liners shall be equal to or better in thermal efficiency than the base specification.

E. Cold surfaces shall have a continuous, unbroken vapor seal.
   1. Provide a complete vapor retarding jacket for insulation on the following systems:
      a) Insulated Duct.
      b) Ductwork with a surface temperature below 65 degrees F.

F. Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing the insulation.

G. Where insulated low temperature (below 45ºF) ductwork is supported by steel metal straps or wire ropes that are secured directly to the duct, the straps or ropes shall be completely covered with insulation and sealed to provide a complete vapor retarding barrier.

H. Where insulated duct risers are supported by steel channels secured directly to the duct, extend the insulation and vapor retarding jacketing to encapsulate the support channels.

I. Provide for operation and viewing of all name plates, controls, instruments and dampers.
   1. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.
J. Ducts shall be clean and dry before applying insulation or liner.
K. Outside air and combustion air intake ducts shall be insulated from intake to unit. Any mixed air ductwork (outside air and return air) shall be insulated as per outside air ductwork.
L. Exhaust and relief air ducts between motorized or back-draft damper and air discharge to outside, shall be insulated. Insulation shall extend 10'-0" from damper into building.
M. Cooling supply air ductwork, round and rectangular, shall be externally insulated from AHU to VAV box.
N. Round and rectangular cooling supply air duct downstream from VAV box shall be externally insulated.
O. Insulate reheat coil casings as specified for supply air ductwork.
P. Where humidifiers are installed in ductwork, the duct 10 feet downstream and 5 feet upstream of humidifier, shall be sheet metal interior construction, externally insulated.
Q. Install duct liners on return and exhaust air ductwork connecting to ventilation equipment for 25 lineal feet out from unit; and at other points indicated. Joint where liner ends and bare duct starts, to be flush and smooth to air flow.
R. Install acoustic duct liner on inside of all curbs for power roof exhausters.
S. Install duct liner in transfer ducts above ceilings.
T. External supply duct insulation is not required where ductwork contains continuous 1" acoustical liner. Provide 4" overlap of external insulation over ends of acoustically lined sections.
U. Do not apply lining to the following ductwork:
   1. Outside air ductwork.
   2. Supply, return and exhaust ductwork associated with shop ventilation systems where air handling units are located in the shops.

3.02 DUCT INSULATION AND LINER SCHEDULE
A. See schedule on plans for a Duct Insulation and Liner Schedule by system.
B. Duct Insulation Type & Thickness:
   2. Concealed Indoors: Cooling Supply Air, TYPE W2 - 1-1/2 inch 1# density blanket.
   3. Exposed Indoors: Outside, Relief, Mixed, Supply and Exhaust Air, TYPE W3 - 2 inch, 3# density board.
      a) All ducts in Mechanical Rooms.
      b) Within 6 feet of floor in other areas.
   4. Visible Indoors: Round Cooling Supply Air, TYPE W4 - 2 inch 2.5# density semi-rigid.
      a) Exposed supply air to VAV boxes.
   5. Visible Indoors: Rectangular Cooling Supply Air, TYPE W5 - 2 inch 3# density board.
      a) Exposed supply branch ducts located in the space they are serving downstream of VAV boxes DO NOT require insulation. Exposed supply main ducts running through spaces they serve shall be insulated as exposed supply ducts scheduled above.
   6. All ducts exposed to weather:
      a) Pre-insulated outdoor duct system. See Specifications Section 23 31 00 system description.
      b) TYPE W6 - 3 inch, polyisocyanurate foam board.
         1) Use tapered insulation on top of duct to help eliminate ponding of water.
7. Exhaust and relief air ducts between motorized or gravity back-draft damper and air discharge to outside, TYPE W3 - 2 inch, 3# density board or TYPE W2 - 2 inch, 1# density blanket.
   a) Insulation shall extend 10'-0" from damper into building, or as indicated on plans.
8. Louver Blank-off Panels, TYPE W3 - 2 inch, 3# density board.

C. Duct Liner, Insulation Thickness:
   1. Transfer air, 1 inch. – Where shown on plans or described here within.
   2. Exhaust air, 1 inch. – Where shown on plans or described here within.
   3. Roof curbs, 1.5 inch.

3.03 PRE-INSULATED OUTDOOR DUCT INSULATION SYSTEMS
A. All pre-insulated ductwork exposed to outdoor weather elements shall have a minimum R-16 insulation value.

3.04 OUTDOOR DUCT INSULATION AND WATERPROOFING
A. All ductwork exposed to outdoor weather elements shall have a minimum insulation thickness of 3 inches.
B. No fibrous board products shall be used.
C. Ductwork joints, slips and drives to be sealed prior to installation of insulation.
D. Utilize foam board insulation cut and taped at the standing seam to create a smooth surface to tape from duct to duct section at the seam.
   1. The top surface shall have additional tapered insulation applied with a minimum of 1/8” per foot taper to eliminate ponding and create positive drainage off of insulation. DO NOT use wood blocks to achieve slope.

3.05 OUTDOOR INSULATION JACKETS
A. Extruded insulation board shall be covered with one of the jacketing products listed.
B. Strictly follow the products installation instructions including special procedures that may apply for applications in cold weather.
   1. Jacketing system shall be covered by a 10-year warrantee.
C. DO NOT penetrate insulation jacket with duct supports.

3.06 PAINTING
A. Coordinate with the General Contractor when piping is to be painted. Oil based paints are not acceptable, as the solvents cause the self-sealing joint on the pipe insulation to fail. Masking the joint is not acceptable. If the insulation taping is rippled due to the oil based application, the Painter shall be responsible for replacement of the insulation. (Certain Class A, non-combustible paints may maintain a 25/50 rating for the painted duct insulation. Check with the state and local building codes and fire marshal for approved practice before painting.)

END OF SECTION 23 07 13
PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Pipe insulation herein specified, applies to all mechanical systems piping, as indicated under EXECUTION.

1.03 RELATED WORK

A. Piping: Section 23 21 10.

B. Piping Supports: Section 23 21 13.

1.04 SUBMITTALS

A. Submit in accord with Section 01300.
   1. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Refer to Article 5, paragraph 5.2 of the General Conditions of the Contract for Construction (AIA Document A201).

B. Installer Qualifications: A qualified installer who has been trained by and is acceptable to manufacturer to install manufacturer's products.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section “Piping Support Devices.”
   1. Coordinate clearance requirements with piping installer for piping insulation application.

1.07 DELIVERY AND STORAGE OF MATERIALS

A. Delivery: Deliver materials in manufacturer’s original packaging.

B. Storage: Store and protect products in accordance with manufacturer's instructions. Store in a dry indoors location. Protect insulation materials from moisture and soiling.

C. Do not install insulation that has been damaged or wet. Remove it from jobsite.
PART 2: PRODUCTS

2.01 PIPE INSULATION COVERING

A. Based on product by Johns Manville, Armacell.
   1. Knauf, Manson and Owens-Corning equals are acceptable.
   2. Pipe insulation and components shall meet ASTM E-84, NFPA 255 or U.L. 723 tests, Flame Spread 25 and Smoke Dev. 50.
   3. Materials or accessories containing asbestos will not be accepted.

The following may be substituted for fiberglass base specification providing the system temperature is within the manufacturer’s respective operating range, the Flame Spread and Smoke Dev. ratings are not exceeded, the thickness is adjusted according to the respective "R" values per following tables and installed as follows:

a. Armacell AP Armaflex black flexible elastomeric thermal insulation, expanded closed-cell structure, unslit, 3/8", ½", ¾", 1", and 1 ½" thick, 25/50 flame and smoke rating for use in air plenums, manufactured without the use of CFC’s, HFC’s or HCFC’s, formaldehyde free, low VOCs, fiber free, dust free, resists mold and mildew, made with Microban antimicrobial product, water vapor transmission of 0.05 perm-inch, up to 6" IPS, meets the energy code requirements of ASHRAE 90.1, ASHRAE 90.2, International Energy Conservation Code (IECC) and other building codes, conforms to NFPA 90A and 90B requirements, K=0.25 per inch and R=4.0 per inch based on flat surface rather than radial surface, recommended temperature usage range of -297°F to 220°F.

b. Armacell AP Armaflex SS self-seal black flexible elastomeric thermal insulation, expanded closed-cell structure, ½", ¾", and 1" thick, 25/50 flame and smoke rating for use in air plenums, manufactured without the use of CFC’s, HFC’s or HCFC’s, formaldehyde free, low VOCs, fiber free, dust free, resists mold and mildew, made with Microban antimicrobial product, water vapor transmission of 0.05, up to 4" IPS, meets the energy code requirements of ASHRAE 90.1, ASHRAE 90.2, International Energy Conservation Code (IECC) and other building codes, conforms to NFPA 90A and 90B requirements, K=0.24 per inch and R=4.0 per inch based on flat surface rather than radial surface, recommended temperature usage range of -297°F to 180°F.

c. Armacell AP Armaflex W self-seal white flexible elastomeric thermal insulation, expanded closed-cell structure, unslit, ½", ¾", and 1" thick, 25/50 flame and smoke rating for use in air plenums, manufactured without the use of CFC’s, HFC’s or HCFC’s, formaldehyde free, low VOCs, fiber free, dust free, resists mold and mildew, made with Microban antimicrobial product, water vapor transmission of 0.05, up to 4" IPS, conforms to NFPA 90A and 90B requirements, K=0.25 per inch and R=4.0 per inch based on flat surface rather than radial surface, recommended temperature usage range of -297°F to 220°F.

d. Apply Armaflex 520 adhesive to all joints and seams to seal water tight as recommended by manufacturer.

e. Aerocel is a highly flexible, closed-cell and lightweight EPDM-rubber based elastomeric product. The product is UV resistant and has a 25/50 flame and smoke rating. Aerocel is designed for installation above and below ground, indoors or outdoors. No protective finish required. K=0.245 per inch. Aerocel has a self-seal protape to seal and overlap each joint.

f. Rubatex "Insul-Tube" flexible elastomeric thermal insulation, expanded closed-cell structure, unslit or factory slit, black, 3/8", ½", ¾/4" and 1" thick, 25/50 flame and smoke rating, water vapor transmission of 0.10, up to 5" IPS, K=0.277 per inch, R=3.61 per inch, -40°F to 220°F.
g. Rubatex "Insul-Lock" flexible elastomeric thermal insulation, expanded closed-cell structure, self-seal, pre-slit, black, 3/8" and ½" thick, 25/50 flame and smoke rating, water vapor transmission of 0.10, up to 2-1/8" insulation I.D., K=0.277 per inch, R=3.61 per inch, -40°F to 220°F.

h. Fittings: Fabricate fitting covers from properly miter-cut pieces as recommended by manufacturer.

i. Flanges, valves, water meters, reduced pressure principle backflow preventers, check valves, pressure reducing valves, strainers, etc: Fabricate covers from properly cut pieces of sheet material as recommended by manufacturer.

j. Apply Armadex 520 adhesive to all joints and seams to seal water tight as recommended by manufacturer.

k. All flexible elastomeric/foam plastic/rubber pipe insulation installed on the Project shall be of the same manufacturer.

l. Foam plastic insulations shall not be installed exposed in areas of human occupancy or egress, but may be installed in equipment rooms, storage rooms, non-ventilated ceilings, etc.

1) AP Armaflex and Self Seal Armaflex may be used provided its horizontal or vertical projected area is less than 10% of the projected building interior adjacent to the piping.

m. Installation shall conform to manufacturer's published installation instructions.

4. Insulations exceeding Smoke Dev. 50 shall not be installed in ceiling air plenums.

B. Cold Piping, Chilled Water and Refrigerant Suction Piping

1. Minimum temperature, 0 degrees F.

2. Armacell AP Armaflex (FS) black flexible elastomeric thermal insulation, expanded closed-cell structure, unslit, 3/8", ½", ¾", 1", 1 ½", and 2" thick, 25/50 flame and smoke rating for use in air plenums, manufactured without the use of CFC’s, HFC’s or HCFC’s, formaldehyde free, low VOCs, fiber free, dust free, resists mold and mildew, made with Microban antimicrobial product, water vapor transmission of 0.05 perm-inch, up to 6" IPS, meets the energy code requirements of ASHRAE 90.1, ASHRAE 90.2, International Energy Conservation Code (IECC) and other building codes, conforms to NFPA 90A and 90B requirements, K=0.25 per inch and R=4.0 per inch based on flat surface rather than radial surface, recommended temperature usage range of -29°F to 220°F.

3. Armacell AP Armaflex LapSeal black flexible elastomeric thermal insulation with vapor barrier jacket with pressure sensitive tape lap sealing system with matching butt strips, expanded closed-cell structure, unslit, 3/8", ½", ¾", 1", 1 ½", and 2" thick, 25/50 flame and smoke rating for use in air plenums, manufactured without the use of CFC’s, HFC’s or HCFC’s, formaldehyde free, low VOCs, fiber free, dust free, resists mold and mildew, made with Microban antimicrobial product, water vapor transmission of 0.05 perm-inch, up to 6" IPS, meets the energy code requirements of ASHRAE 90.1, ASHRAE 90.2, International Energy Conservation Code (IECC) and other building codes, conforms to NFPA 90A and 90B requirements, K=0.25 per inch and R=4.0 per inch based on flat surface rather than radial surface, recommended temperature usage range of -29°F to 220°F.

4. Apply Armaflex 520 adhesive to all joints and seams to seal water tight as recommended by manufacturer.

5. All flexible elastomeric/foam plastic/rubber pipe insulation installed on the Project shall be of the same manufacturer.

6. Installation shall conform to manufacturer's published installation instructions.
C. Hot Piping, Concealed or Exposed Indoors:
1. Maximum temperature +500°F.
2. Manville Micro-Lok HP Ultra fiberglass insulation with factory applied polypropylene (Poly ASJ) coated vapor barrier jacket with pressure sensitive tape lap sealing system with matching butt strips. (To be installed only when air temperatures are between 20°F and 130°F.) or
3. Manville Micro-Lok fiberglass insulation with factory applied "AP" vapor barrier jacket secured with CMC 17-465 adhesive and stapled. Coat staples with vapor barrier mastic. (May be installed when air temperatures are lower than 20°F or more than 130°F.)
4. Fittings under 3 inch, insulate with insulation cement to thickness of adjoining pipe. Fittings 3" and larger shall be insulated with segmented or moulded insulation of same material and thickness as adjoining pipe, secured with galvanized steel wire and finished with a smoothing coat of insulation cement. Apply mastic and reinforced fiberglass mesh or at Contractor's option, canvas covering with fire-safe adhesive; Foster 30-36 (two coats).
   a. At Contractor's option, Manville "Zeston", Foster "Speedline 25/50 Smoke-Safe" or Universal insulated fitting covers may be used provided: installation conforms to manufacturer's recommendations; fiberglass insulation insert thickness is the same or greater than specified for adjacent piping; tack fasteners are used on all joints; and State flame spread and smoke developed ratings are complied with.
   b. At Contractor's option: may use pipe insulation of same material and thickness, size as required to overlap onto adjoining pipe insulation, with exposed joints and ends sealed.
5. Thermal conductivity: \( R = \frac{4.3}{K} = .23 \) at +75°F. mean temperature, 1 inch thick.

D. Adhesives, Tapes, and Finishes:
1. Longitudinal seam closure is to be Stay-Seal with Protape and butting sections are to be joined with Cel-Link II pressure-sensitive closures. Closures must provide water and water vapor tight seal when tested in accordance with ASRM D 3816. VOC content must be no more than 1.3% when tested in accordance with ASTM 3960. Closures must be capable of being sealed at a low temperature of 0°F. Closures must be kept free of dust, dirt, moisture, lubricants and other contaminants.
2. Adhesive for fabrication work such as field-fabricated fittings and sheet seams shall be the insulation manufacturer's recommended contact adhesive: Aerocel Aeroseal Adhesive or Aeroseal LVOC Adhesive.
3. Optional insulation finish shall be the insulation manufacturer's recommended finish: Aerocel Aerocoat.
4. Seaming tape to be 15-mil EPDM rubber with acrylic adhesive: Aerocel Protape.
5. Elbows, suction line "P" traps, tees and mechanical grooved pipe fittings are to be insulated with factory fabricated insulation fittings of EPDM flexible elastomeric, color matched to pipe insulation. Aerofit Insulating Fitting Covers.
6. Accessories such as adhesives, mastics and cements shall not detract from any of the system ratings as specified above.

E. Factory Fabricated Insulating Fitting Covers
1. Insulating fitting covers for copper sweat x sweat 90 degree elbows, tee's and 45 degree elbows, and mechanical grooved fittings will be factory-fabricated insulating fitting covers. The insulating fitting covers are to be made of EPDM rubber, with inside diameter and insulation thickness to match material on straight run piping. Aeroflex USA Aerofit insulating fitting covers.
F. Hot Piping, Underfloor - In Contact with Soil:
   1. Maximum temperature over +220°F; also applicable to steam returns over 3 inch I.D. Fiberglass insulation (as specified here before for hot piping), with one of the following waterproofing procedures:
      a. Armstrong "Armaflex" plastic insulation, 3/8 inch thick, lapped and sealed over fiberglass. (Fiberglass insulation thickness in schedule may include "Armaflex").
      b. Installed in V.C. tile pipe with cement joints.
      c. Grace "Bituthene" waterproofing, one layer, lapped 2-1/2" (maximum) both ways and sealed; as per manufacturer's recommendations.
      d. Armstrong "Polyguard 800" primer and membrane, 1 layer, lapped 2-1/2" and sealed; as per manufacturer's recommendations.
   2. Maximum temperature +220°F.
      a. Armstrong "AP Armaflex" elastomeric thermal insulation; all joints and seams sealed with Armstrong 520 adhesive.
      b. Fittings shall be insulated with flexible tubing or sheet insulation mitered and formed, all joints sealed with Armstrong 520 adhesive.
      c. Thermal conductivity:  R = 3.7 / K = .27 at +75°F. mean temperature, 1 inch thick.

G. Cold and Hot Piping, Insulation Thickness: Provide as scheduled below:

<table>
<thead>
<tr>
<th>HVAC Piping Minimum Insulation (inches) ASHRAE/IES Standard 90.1 and IECC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Hot Systems with rigid fiberglass (Steam, Steam Condensate, Pump Discharge and Hot Water-Heating)</td>
</tr>
<tr>
<td>Above 350</td>
</tr>
<tr>
<td>251 - 350</td>
</tr>
<tr>
<td>201 - 250</td>
</tr>
<tr>
<td>141 - 200</td>
</tr>
<tr>
<td>105 - 140</td>
</tr>
<tr>
<td>Cold Systems must be closed cell (Chilled Water, Well Water Cooling Supply, Brine, and Refrigerant)</td>
</tr>
<tr>
<td>40 - 55</td>
</tr>
<tr>
<td>Below 40</td>
</tr>
<tr>
<td>Below 32 polyisocyanurate</td>
</tr>
<tr>
<td>Well Water Condenser Discharge; Condensate Drains must be closed cell</td>
</tr>
<tr>
<td>40 - 75</td>
</tr>
</tbody>
</table>

HVAC system piping, and related HVAC fluid conveying conduit, such as heat exchanger bodies, shall be thermally insulated in accordance with the Table above.
The required minimum thicknesses do not consider water vapor transmission and condensation. Additional insulation, vapor retarders, or both, may be required to limit water vapor transmission and condensation.
Refer to the Wisconsin Administrative Code Appendix A63.29 for Alternative HVAC piping insulation types.
2.02 METAL INSULATION PROTECTION SHIELDS

A. Based on B-Line Systems Inc.
   1. Buckaroo equals are acceptable.

B. B-Line Systems Inc. Figure B3151, 18 to 12 gauge galvanized steel and 12 to 24 inch long respectively or

C. B-Line Systems Inc. Figure B3154 short insulation protection shield, 18 gauge galvanized steel and 8 to 12 inch long.

2.03 INSULATED PIPE SUPPORT INSERTS

A. Insulated pipe support inserts will be high-density insulation with an inner lining of EPDM rubber insulating tape and an EPDM rubber exterior jacket: Aerocel Aerofix-U Pipe Hanger Inserts.

B. Density of insulation is to be a minimum of 10 lbs./cu. ft., with a compressive strength of 284 P.S.I. or greater, and a k-value of .312 or lower, usage temperature range of -297°F to 257°F, water absorption of 5% or less. Exterior jacket is to be 15-mil thick EPDM rubber.

C. Wood blocks will not be accepted.

2.04 STRUT PIPE SUPPORT CLAMP INSERTS (See Section 23 21 13)

2.05 PIPE INSULATION FITTING COVERS AND JACKETING

A. Based on Manville.
   1. Proto PVC equals are acceptable.
      a. High impact, gloss white, UV resistant, polyvinyl chloride.
      b. Fitting covers for 45° and 90° short and long radius elbows, tees and valves, flanges, reducers, end caps, soil pipe hubs, traps and mechanical groove-type fittings
      c. Jacketing available in rolls in thicknesses of 10, 15, 20, and 30 mil. The 20 or 30 mil thicknesses are recommended for outdoor applications and is factory-cut to fit up to 30” O.D. piping.
      d. Sections of System 2000 PVC Cut & Curled Jacketing are 48” in length and are factory curled to fit snugly.
      e. PVC covers must be kept below 150°F, kept away from contact with, or exposure to, sources of direct or radiated heat.
      f. An approved vapor retarder mastic compatible with PVC must be applied between pipe insulation and fitting cover, and on fitting cover throat overlap seam.
      g. For totally sealed systems (USDA Approval), use 20 or 30 mil Zeston PVC jacketing applied to pipe insulation in conjunction with Zeston PVC fitting covers.
         1) All circumferential and longitudinal seams of jackets and fitting covers should be sealed with Zeston Perma-Weld adhesive. Circumferential seams should be a minimum 1” overlap, and longitudinal seams should be 1 ½” to 2” overlap.
         2) Slip joints are required periodically between fixed supports and on continuous long runs of straight piping. Slip joints are achieved by increasing circumferential overlap to 8 to 10 inches and applying a flexible white caulking in the overlap area to maintain a sealed system.
      h. Installation shall conform to manufacturer’s published installation instructions.
PART 3: EXECUTION

3.01 PIPE INSULATION COVERING

A. Covering shall be installed as per the manufacturer’s recommendations, by a qualified insulation subcontractor, after piping has been tested, as specified.

B. The inside diameter of insulation shall match outside diameter of the tubing or piping being insulated. Improper insulation size or thickness will not be acceptable.

C. All covering shall be continuous through walls, floors, ceilings, sleeves, and other openings. Insulation on cold surfaces shall have a continuous, unbroken vapor seal; vapor barrier joints shall be sealed and lapped. Self-sealing lap joints shall be stapled.
   1. Provide a complete vapor retarding jacket for insulation on the following systems:
      a. Cold Water Make-Up
      b. Chilled Water
      c. Refrigerant
      d. Glycol/Brine
      e. Piping with a surface temperature below 65 degrees F

D. Insulating pipe saddles are to be installed at all pipe hanger and clamp locations. Saddles are to be installed at the time that piping is being installed, so that insulation system can be installed in a continuous manner through the pipe support system.

E. Insulation shall be equal to or better in thermal efficiency than the base specification, or additional thickness shall be provided. At a minimum, thicknesses used will be in accordance with the thickness tables for piping and duct insulation used in the latest version of ASHRAE 90.1 and must meet local building code requirements. These thicknesses may or may not be sufficient to control condensation. Thicknesses required to control condensation may be greater than the recommendations of ASHRAE 90.1.

F. Provide for operation and viewing of name plates, controls, instruments, valve bonnets and stems. Insulate flanges, valve bodies, strainers, etc. as hereafter specified:
   1. Balancing stations shall be insulated with a removable type enclosure. Removable straps shall be required for reinstallation.
   2. Ball Valves (heating system): Insulate body, taper insulation and provide clearance at valve stem/handle so operation of valve handle does not rub or otherwise damage the insulation.
   3. Ball Valves (cooling system): Insulate body up to non-rotating stem extension sleeve and provide a tight vapor seal.
   5. Butterfly valves (Heating system): hot piping (above 260°F), insulate as specified for fittings.
   7. Check Valves (heating system): Insulate body, taper insulation and provide clearance for servicing.
   8. Flanges (Heating system): hot piping (below 260°F), insulation shall stop just prior to flanges to allow access to bolts without affecting insulation, with ends of insulation tapered and finished.
   9. Flanges (Heating system): hot piping (above 260°F), insulate flanges as specified for fittings.
10. Flanges (cooling system): insulation shall stop at flanges and sealed, then cover flanges with ½" flexible foamplastic "slip cover", to fit snugly against piping insulation forming a tight vapor seal - "slip cover" shall be removable.
   a. At Contractor's option: may use pipe insulation of same material and thickness, size as required to overlap onto adjoining pipe insulation, with exposed joints and ends sealed.

11. Gate/globe valves (Heating system): (below 260°F), insulate only body of valve, up to flanges and bonnet, as specified for fittings and flanges above.

12. Gate/globe valves (Heating system): (above 260°F), insulate body, flanges and bonnet.

13. Gate/globe valves (cooling system): insulate body of valve, including bonnet and flanges as specified for fittings and flanges above.

14. Strainers: Insulate body and/or flanges as specified for valves and flanges; do not insulate removable portion.

15. Unions (Heating system): insulation shall stop at unions with ends of insulation tapered and finished.

16. Unions (cooling system): insulate with flexible elastomeric insulation or as specified for fittings.

17. Accessories and Specialties in hot piping, insulation is not required for such items as thermometer wells, gauge tappings, flexible connectors, vibration-control devices; in cold piping where condensation will occur, these items will be insulated as specified for fittings.

G. Pipes shall be clean and dry before insulation is applied.

H. Maximum lengths of pipe insulation shall be used in rooms with exposed ceilings, mechanical equipment rooms, etc. where highly visible. Short lengths may be used above ceilings. (Vapor barrier seal shall be maintained on all cold water piping).

I. No additional coating or finish is required for weathering resistance. Coatings or jacket may be required for aesthetic, damage resistance, or vapor barrier enhancement purposes.

3.02 INSULATED INSERTS AND METAL INSULATION PROTECTION SHIELDS

A. Provide insulated inserts and shields as follows:
   1. Rigid insulation inserts shall be installed between the pipe and the insulation shields.
   2. Quantity and placement of inserts shall be according to the manufacturer's installation instructions, however the inserts shall be no less than 12" in length.
   3. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required for system.
   4. Chilled water piping (Continuous insulation with vapor barrier maintained).
      a. All insulated piping shall be provided with oversized hangers.
      b. Provide insulation inserts and pipe shields at all hanger and support locations.
         1) Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
      c. Shields may be omitted if pipe hanger is insulated with piping.
   5. Heating piping.
      a. All insulated piping shall be provided with oversized hangers.
      b. Provide insulation inserts and pipe shields at all hanger and support locations.
         1) Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
      c. Shields may be omitted if pipe hanger is insulated with piping.

3.03 STRUT PIPE SUPPORT CLAMP INSERTS (See Section 23 21 13)
3.04 PIPE INSULATION FITTING COVERS AND JACKETING

A. To be used on all new and existing exposed piping in the following areas:
   1. All piping within mechanical rooms.
   2. All piping exposed within 6'-0” above finished floor.
   3. Piping exposed in occupied finished locations

B. Maximum lengths of jacketing shall be used where highly visible.

C. Position joints in jacketing towards wall or ceiling as applicable in order to conceal the joint.

3.05 HVC PIPING INSULATION

A. Steam and hot water heating supply and return piping, condensate pump discharge lines, chilled water supply and return piping, dual-temp supply and return piping, heat recovery supply and return piping and condensate (cooling) drains above ground inside building will be insulated, including piping in tunnels, suspended ceilings and soffits; modified as follows:
   1. Exposed heating piping at radiation connections will not be insulated.
   2. Piping between control valves and AH unit coils and duct coils will be insulated.
   3. Underground (underfloor) hot water and steam heating supply and return piping, will be insulated.
   4. Balancing stations shall be insulated with a removable type enclosure. Removable straps shall be required for reinstallation.

3.06 COLD PIPING

A. Cold systems (Chilled Water, Well Water Cooling, Brine and Refrigerant piping shall not be insulated with fiberglass insulation.) Insulation type to be closed cell.

3.07 EXISTING PIPING

A. Existing piping insulation damaged during construction shall be repaired to match original condition. If corrosion is present, scrape clean and coat the piping with RG2400 type corrosion resistant paint.

3.08 EXTERIOR PIPING

A. Exterior piping shall be insulated as specified for cold water piping with UV resistant insulation and include the following protective covering/finish:
   1. Enclosed with 0.16 aluminum jacketing or ultraviolet safe PVC.

3.09 PAINTING

A. Coordinate with the General Contractor when piping is to be painted. Oil based paints are not acceptable, as the solvents cause the self-sealing joint on the pipe insulation to fail. Masking the joint is not acceptable. If the insulation taping is rippled due to the oil based application, the Painter shall be responsible for replacement of the insulation. (Certain Class A, non-combustible paints may maintain a 25/50 rating for the painted pipe insulation, PVC jacketing and fittings. Check with the state and local building codes and fire marshal for approved practice before painting.)
PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 RELATED WORK

A. Testing: 23 05 92

B. Balancing Systems: 23 05 93

C. Commissioning: 23 08 00

1.03 SUBMITTALS

A. Submit in accord with Division 1.

B. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.

C. Temperature Control Shop Drawings shall include:
   1. System communication trunk layout and wiring diagrams.
   2. Point schedules indicating point type, function, application keyed commands, location and related building equipment. Also, include any other schedules used in particular customized system generation.
   3. Product/equipment/hardware data
   4. System overview and description of operation literature detailing:
      a. System configuration (hardware).
      b. Point/data (system level) organization.
      c. Software features.
      d. Operation features/user direction.
      e. On-line programming (point addition) directions.
      f. Sequence of operations.
   5. Room Schedule
   6. Valve Schedule
   7. Damper Schedule
   8. Relay Schedule (if applicable)
   9. Control drawings, wiring diagrams and description of operation for new controls.
   10. Schedule of graphics that the operator will use to manage the operation.
   11. New product and equipment data.
   13. AE project name and project number.
1.04 WARRANTY

A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of substantial completion.

B. Warranty requirements include furnishing and installing all BAS software upgrades issued by the manufacturer during the two-year warranty period.

PART 2: PRODUCTS

2.01 APPROVALS

A. The temperature control system shall be provided by the Owner. (Western Technical College will hire the temperature control contractor directly).

B. System shall be one of the approved below.
   1. Automated Logic

C. All work described in this section shall be installed under the supervision of factory trained engineers and mechanics qualified for this work and in the regular employ of the system manufacturer's field office.

D. Engineering, programming, testing and calibration and checkout shall be performed by employees of the system manufacturer's field office.

2.02 SYSTEM

A. All new controls shall be direct digital controllers with electronic actuators. All controllers shall be DDC and all control points, with the exception of the perimeter radiation, shall be capable of being viewed from the screen of the BAS monitor.

B. Extend all new DDC components from the existing campus wide Automated Logic automation system.

C. Space Temperature Sensors:
   1. Shall be equipped with a digital display and a concealed setpoint adjustment with temperature adjustment and override button. Covers to be without thermometers and with a tamperproof mounting and an externally accessible override switch. Provide insulated sub-base for all outdoor wall mount locations. Sensors located in corridors, lobbies and entries shall be either stainless steel flat plate temperature sensors or match other sensors except with no adjustment or override.
      a. Flat plate sensors to be BAPI or equal. Thermistor accuracy to be ±0.36F, RTD accuracy to be ±0.27F or semiconductor accuracy to be ±2.7F.
      b. Wiring to be 18/2 shielded plenum cable to sensor to eliminate sensor offset.

D. Control Valves:
   1. Provide all control valves as shown on the plans/details and as required to perform functions specified. Valves must be selected to prevent overlap of operation and simultaneous heating and cooling.
   2. Size operators to allow smooth and positive operation of devices served and to provide sufficient capacity for tight shutoff against system temperatures and pressure encountered.
3. Provide operators that are full-proportioning or two-position, as required for specified sequence of operation. Valve actuators shall be electronic, spring return, low voltage (24 VAC), and properly selected for the valve body and service. Provide spring-return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation. All valve actuators shall be provided with a visible position indicator. Electric actuators, for applications other than terminal units, shall be provided with a manual override capability. Provide operators with linkages and brackets for mounting on device served.
   a. Actuators shall be Belimo

4. Valves shall have stainless steel stems and allow for servicing, two or three way as required. Heating or diverting valves, shall fail to full heat.

Water systems:
   a. Use equal percentage valves for two-way control valves; size for a pressure drop not less than 4 psi or more than 6 psi.
      1) Two-position shut-off valves used for isolation of mechanical devices shall be sized for a maximum pressure drop of 2 PSI at design flow and shall be a minimum of line size.
   b. Use three-way valves sized for a maximum pressure drop of 5 psi and that have linear characteristics so that the valve pressure drop remains constant regardless of the valve position.
      1) Three way valve mixing or diverting configurations shall have factory provided linkage kits specifically manufactured for the piping arrangement and actuator used.
   c. Globe valves 2" and smaller: Bronze body, brass plug and seat, stainless steel stem, composition disc, screwed ends, suitable for use on water systems at 150 psig and 240°F. Seat leakage with actuator supplied will meet ANSI class IV leakage (0.01%). For globe valves that are specified to fail in place, valves shall be open when the stem is up. Minimum size for globe valves shall be 1.5 Cv.
   d. Globe valves 2-1/2" and larger: Iron body, brass plug and seat, stainless steel stem, spring loaded Teflon packing, flanged ends, suitable for use on water systems at 150 psig and 240°F.
   e. Butterfly valves 2-1/2" and larger: Iron body, stainless steel shaft, bronze bearings, and resilient seat. Disc to be aluminum-bronze, nickel plated ductile iron, cast iron with welded nickel edge, or stainless steel. Valve assembly to be bubble tight and shall be installed between flanges in such a manner that the valve body is under compression at all times. Valve assembly shall be suitable for use on water systems at 150 psig and 240°F. When butterfly valves are used in modulating applications, entering and leaving pipe sizes and required transition distances shall be detailed on the control valve submittals. The control contractor shall be responsible for coordinating the proper pipe sizes and transitions with the mechanical contractor to provide the correct Cv at 70° open position.
   f. Characterized Ball Valves: For use on terminal units only where specified in table below. Forged bronze body, stainless steel shaft and ball, reinforced Teflon or PTFE ball seals, double O-ring stem seals, characterized disk, maximum of ANSI Class IV (0.01%) leakage, suitable for use on water systems at 150 psig and 212°F. Minimum size for ball valves shall be 1.0 Cv.
g. Pressure Independent Characterized Ball Valves: The following manufacturers and models are acceptable: Belimo model PICCV, Griswold Controls PIC-V, and Flow Control model DeltaPValve. Forged brass or bronze body, reinforced Teflon or PTFE ball seals, double O-ring stem seals, characterized disk, maximum of ANSI Class IV (0.01%) leakage, suitable for use on water systems at 150 psig and 212° F. Flow shall be varied by actuator position and at any given position, flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations across the valve in the selected operating range. Valves shall be pressure independent between a system differential pressure of 8 and 50 PSID. Minimum size for ball valves shall be 0.4 Cv. Control valves shall be factory set not-to-exceed the coil design flow rate. All control valves shall have three (3) factory-installed Pressure/Temperature ports to allow factory and field verification of flow and proper operation. These ports shall be located at the inlet, intermediate, and outlet locations of the valve. The intermediate port must be located between the control surface and pressure regulator.

h. Valve shut-off capability shall exceed the maximum head capacity of the circulating pumps.

i. All valves unless specifically noted on the plans or indicated below shall be globe style valves.

<table>
<thead>
<tr>
<th>VALVE SERVING</th>
<th>TYPE</th>
<th>SIGNAL</th>
<th>SPRING RETURN REQUIRED</th>
<th>FAIL POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Globe</td>
<td>0-10 VDC</td>
<td>Yes</td>
<td>Open (thru Coil)</td>
</tr>
<tr>
<td></td>
<td>Butterfly (BF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball</td>
<td>0-10 VDC</td>
<td>No</td>
<td>Closed (bypass Coil)</td>
</tr>
<tr>
<td></td>
<td>Press</td>
<td></td>
<td></td>
<td>Last Position</td>
</tr>
<tr>
<td></td>
<td>Independent Ball (PI Ball)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reheat Coil</td>
<td>Globe or Ball</td>
<td>0-10 VDC</td>
<td>No</td>
<td>Last Position</td>
</tr>
<tr>
<td>Radiation w/Reheat</td>
<td>Globe or Ball</td>
<td>0-10 VDC</td>
<td>No</td>
<td>Last Position</td>
</tr>
<tr>
<td>Standalone Radiation</td>
<td>Globe or Ball</td>
<td>0-10 VDC</td>
<td>No</td>
<td>Last Position</td>
</tr>
<tr>
<td>CUH and UH</td>
<td>Globe or Ball</td>
<td>2-Pos Elect</td>
<td>Yes</td>
<td>Open</td>
</tr>
</tbody>
</table>

See plan details, notes, and schedules for where two-way and three-way valves should be used.

1. Equivalent Cv butterfly valves may be used where 2-1/2” and larger globe valves would be required.

E. Temperature sensors shall be Resistance Temperature Detector (RTD) or Thermistor as dictated by the requirements of this specification. Temperature sensing element to be a two wire thermistor rated @10,000 ohms @ 77° F. The sensing element is to be highly stable, accurate to within ± 0.36 degrees Fahrenheit. Provide sensors in occupied spaces with covers to match those specified for thermostats. Provide limited range or extended range sensors if required to sense the range expected for a respective point.

1. Duct sensors shall be rigid or averaging as specified in the sequence of operations. Use averaging elements on duct sensors when the ductwork is four square feet or larger. Averaging sensors shall be a minimum of 5 feet in length. Averaging type shall be used where stratification is likely, such as in the mixed air stream or at the discharge of a coil.
2. Bulb type are acceptable for return of outdoor air. Provide sun shields on outdoor air bulbs and mount on building north wall.
3. Use elements on sensors in piping systems compatible with installation in separable wells. Immersion sensors shall be provided with a separable stainless steel well where liquid temperature sensing is required.

F. Provide transmitter of the range as narrow as practical and still sense the range of expected pressures in the particular application. Pressure sensing tips shall be provided for accurate readings in ducts of static pressure or total pressure as the applications dictate.
G. Humidity sensors shall use thin polymer film or composite organic/inorganic crystal types with a range of 0-100% RH. Accuracy to be no less than ±3% in the range of 20% RH to 80% RH with a response time of 120 seconds or less. Provide sensors in occupied spaces with covers to match those specified for thermostats.

H. Static pressure transmitters shall operate on the capacitance principle and is capable of sensing low positive, negative or differential pressures with the accuracy of ±1% of range (including non-linearity and hysteresis). The output ID 4-20 MA current transformer isolated from the AC power.

I. Provide differential pressure sensors for each fan or pump specified as requiring this device and for each application requiring a status indication, as indicated on the point list. Differential pressure sensing devices shall sense both inlet and outlet of fans and pumps.
   1. Differential Pressure Switches shall be furnished as indicated for status purposes in air and water applications. Provide single pole double throw switch with fully adjustable differential pressure settings.

J. In lieu of differential pressure sensors above, current sensors shall be provided for each fan or pump specified, or shown on point list as requiring this device. Provide a current sensor with adjustable threshold and digital output with LED display, equal to a Veris model H-708.

K. Provide all required power supplies for transducers, sensors, transmitters and relays.

L. Static pressure sensors shall be differential pressure type. The sensor range shall be closely matched to the system static pressure, -.5 to .5 inches, -1 to 1 inch, 0 to 2.5 inches.
   1. Sensor accuracy shall be plus or minus 5% of the sensing range.

M. VAV flow measurement sensors
   1. Flow measurement in VAV systems shall utilize multipoint flow sensing. Single point sensing is not acceptable.
   2. Pressure transducer shall be micro-bridge type with factory mounted - replaceable 5 micron filter to prevent transducer failure. Filter shall be changed and transducer calibrated following job commissioning to prevent filter clogging by construction dust and insure proper operation.
   3. Diaphragm type pressure transducer is also acceptable. Systems using diaphragm type transducers must automatically recalibrate on a regular basis.

N. Vertical scale thermometers shall be 9" high adjustable angle, swivel mount, thermometers of a suitable range. Johnson Controls T-2110, Moeller Instr. Series No. 890,000 or H.O. Trerice Bx9 Series are acceptable. Averaging type thermometer shall be used where stratification is likely. Scale graduations of 2°F and mid-range accuracy of ±1°F. Install thermometers in separable brass wells filled with conductive fluid.

O. Dial thermometers shall be 3-1/2" diameter of suitable range. Johnson Controls, T-2100, Honeywell W-655, Moeller Instr., or H.O. Trerice. Accuracy within 1% of scale range. Thermometers with sensing elements in air ducts with an area of above 4 square feet to have averaging elements. Provide separable wells for all pipeline applications. Averaging type, liquid filled capillary sensing element, thermometer shall be used where stratification is likely. Maximum scale graduations of 2°F.

P. Safety low limit thermostats shall be vapor pressure type with a 20 foot minimum element. Element shall respond to the lowest temperature sensed by any one foot section.
   1. Low limit shall be manual reset only.
   2. High limit thermostats shall be manual reset type set at 120 degrees F.
Q. Freeze protection stats shall have 20 foot vapor tension sensing element designed to permit any point along entire length to trigger the switching action. Furnish one SPST - N.O. switch and one SPST auxiliary N.C. switch. Auto or manual reset as specified. Range to be 35-55 degrees F. with permanent stop at 35°F. Differential on auto reset models to be fixed at approximately 5 degrees.

R. Carbon dioxide monitor
1. Manufacturer: Telaire Systems
   a. Brasch or Veris Industries equals are acceptable.
2. The device shall be an all-digital non-dispersive infrared technology (NDIR) carbon dioxide monitor with diffusion gas sample chamber.
3. The device limits the CO₂ level to any User selectable set point between 50 and 5,000 PPM. The maximum drift per year shall be 100 PPM. Accuracy shall be +/- 30 PPM. Sensor response time shall be less than 1 minute.
4. The device shall be either space mounted or located in the air handling unit return air duct with a duct mounted aspiration box. If space mounted, make provision for wall mounting.
5. The device shall provide a field selectable linear output signal of 0-10 VDC or 4-20 mA for connection to the BAS.
6. Sensor power requirement shall be less than 3W with an input voltage of 20 to 30 VAC/DC. Sensor operating temperature range shall be 0°C to 50°C.
7. The operating parameters of the device shall be capable of being changed from the BAS using a RS-232 interface and a program module provided with the device.
8. Sensor shall be warranted for a minimum of 3 years.

2.03 ELECTRONIC COMPONENTS

A. Low limit thermostats (freezestats) shall be electric two-position type with temperature sensing element and manual reset. Unit to be capable of opening control circuit if any one foot length of sensing element is subject to a temperature below the setpoint. Length of sensing element to be not less than one lineal foot per square foot of coil surface areas. Unless otherwise indicated, set low limit controls at 36°F.

B. Aquastats shall be line voltage type with single pole, single throw switch of adequate rating for the applied load.

C. Relays used for summing, reversing, amplifying, high or low pressure selection, with fixed 1:1 [or adjustable] input/output ratio.

D. Switches shall be provided with indicating plates, accessible adjustment, calibrated and marked.

E. Flow switches shall have snap-action and be magnetically operated, with external adjustment. All wetted parts to be brass or stainless steel; McDonnell No. FS7 or equal.

2.04 Local panels:

A. Panels shall be totally enclosed aluminum, steel or Lexan cabinets with hinged door and keyed lock. Install controls, relays, transducers and automatic switches inside panels. Mount under plastic, a copy of control drawing for each unit and label all equipment in panel identifying them with the drawing. Provide panel with a fused disconnect with all wiring to numbered terminal strips corresponding to control drawings. Indicate if other disconnects are required to remove power from the panel for servicing.
1. Manual switches including "manual-automatic switches", dial thermometers, pressure gauges, and receiver indicating gauges shall be flush mounted in front door of panel. Clearly identify each item with engraved nameplates.
2.05 ORIGINAL EQUIPMENT MANUFACTURER (OEM) CONTROLLER DDC INTEGRATION:

A. Provide DDC programming to define all equipment integral input/output points, setpoints, data points, calculations, etc. that are available through the manufacturers communication interface. Consult with the A/E to determine if some of the points should be omitted (for clarity or lack of value). The following equipment shall be integrated into the DDC system:
   1. Variable Frequency Drives
   2. Rooftop Units

B. Points shall be monitored/controlled by the BAS and displayed graphically on BAS for each piece of equipment.

PART 3: EXECUTION (SEQUENCE OF OPERATION)

3.01 DEVICE LOCATIONS

A. Locations of sensors, panels, etc. shown on drawings are diagrammatic. All locations shall be verified to avoid interference with other items or furnishings (refer to architectural and electrical drawings). Where sensors are located near light switches, mount the sensors adjacent to light switches.

B. Mount temperature sensors 48" above floor to comply with American Disabilities Act. Sensors that are the flat plate stainless steel style without adjustability or visual indication would not need to comply with the 48" requirement.

C. Sensors located in locker rooms, gymnasiums, corridors, all public areas and entries shall be surface applied to the back of a stainless steel flush mounted plate attached with tamper proof screws to an electrical box recessed in the wall. Refer to plans for locations. Sensors in Classrooms and Offices shall not be required to be tamper proof type.

3.02 ELECTRICAL WIRING

A. The Contractor shall provide all temperature control wiring and conduit in connection with the control system including control panels, relays, transformers and low temperature protection thermostats. All sensor wiring and output wiring from DDC system shall be installed in conduit or metal wiring trough in exposed areas with all wiring leads numbered for identification and shall conform to NEC requirements. Install all wiring, including thermostat or temperature sensor wiring from ceiling in masonry or drywall constructed walls in metal conduit (EMT). Plenum approved cable is permitted. All line voltage and power wiring must be installed under this Section per requirements of Division 26 of this specification and the National Electrical code.
   1. All control components shall have composite fire and smoke hazard ratings meeting NFPA 90-A and 90-B, Flame Spread 25 and Smoke Developed 50.

B. Provide all required transformers for sensing, transmitting and control devices.

C. Provide all electrical relays and wiring, line and low voltage, for control systems, devices and components.

D. Install "hand/off/auto" selector switches on systems where automatic interlock controls are specified. When switch is in "hand" position, allow manual operation of the selected device without operating the interlocked motors but allowing all unit safety devices to stay in the circuit.

E. Provide all power (low and line voltage) required by T.C. sensors, transmitters and other control or sending devices. Install both high and low voltage wiring in accordance with Division 26 specifications.
F. Install control cabinets as shown on drawings or in locations that have been approved.

G. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

H. Miscellaneous devices:
   1. Provide miscellaneous devices (relays, switches, transformers, etc.) required to accomplish the control sequences specified. Devices shall be of the best quality with proper ranges and mounting arrangements.

3.03 CABINET HEATER AND UNIT HEATER CONTROL (HOT WATER)

A. Provide a temperature sensor (DDC), 2-way or 3-way hot water valve for each unit.

B. The control valve shall open when the space temperature drops below the space temperature setpoint. Setpoint temperature shall be set with the BAS and shall be user adjustable with the BAS. When the setpoint temperature is met, the control valve shall close. The fan shall cycle off.

C. Set thermostat to maintain a minimum space temperature of 60°F (adjustable).

D. Send alarm to the BAS if space temperature falls 10°F (adjustable) below setpoint.

E. All points and alarms listed above shall be displayed graphically on BAS.

3.04 GAS ROOFTOP UNIT CONTROL

A. Provide equipment integration as noted above.

B. Building Automation System Interface:
   1. The Building Automation System (BAS) shall send the controller Occupied Bypass, Morning Warm-up / Pre-Cool, Occupied / Unoccupied and Heat / Cool modes. If a BAS is not present, or communication is lost with the BAS the controller shall operate using default modes and setpoints.

C. Occupied Mode:
   1. During occupied periods, the supply fan shall run continuously and the outside air damper shall open to maintain minimum ventilation requirements. The unit controller shall control the supply fan speed to maintain the current duct static pressure setpoint (adj.). The DX cooling shall stage and gas heat shall modulate to maintain the current discharge air temperature setpoint. If economizing is enabled the outside air damper shall modulate to maintain the current discharge air temperature setpoint.

D. Unoccupied Mode:
   1. When the space temperature is below the unoccupied heating setpoint of 60.0 deg. F (adj.) the supply fan shall modulate as necessary to maintain duct static pressure setpoint (adj.), the outside air damper shall remain closed and the gas heat shall be enabled. When the space temperature rises above the unoccupied heating setpoint of 60.0 deg. F (adj.) plus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop and the gas heat shall be disabled.

   2. When the space temperature is above the unoccupied cooling setpoint of 85.0 deg. F (adj.) the supply fan shall modulate as necessary to maintain duct static pressure setpoint (adj.), the outside air damper shall open if economizing is enabled and remain closed if economizing is disabled and the DX cooling shall be enabled. When the space temperature falls below the unoccupied cooling setpoint of 85.0 deg. F (adj.) minus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop, the DX cooling shall be disabled and the outside air damper shall close.
E. Optimal Start:
   1. The BAS shall monitor the scheduled occupied time, occupied space setpoints and space
temperature to calculate when the optimal start occurs.

F. Morning Warm-Up Mode:
   1. During optimal start, if the average space temperature is below the occupied heating setpoint
   a morning warm-up mode shall be activated. When morning warm-up is initiated the unit
   shall enable the heating and supply fan. The outside air damper shall remain closed. When
   the average space temperature reaches the occupied heating setpoint (adj.), the unit shall
   transition to the occupied mode.

G. Pre-Cool Mode:
   1. During optimal start, if the average space temperature is above the occupied cooling
   setpoint, pre-cool mode shall be activated. When pre-cool is initiated the unit shall enable
   the fan and cooling or economizer. The outside air damper shall remain closed, unless
   economizing. When the average space temperature reaches occupied cooling setpoint
   (adj.), the unit shall transition to the occupied mode.

H. Optimal Stop:
   1. The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space
   temperature to calculate when the optimal stop occurs. When the optimal stop mode is
   active the unit controller shall maintain the space temperature to the space temperature
   offset setpoint.

I. Occupied Bypass:
   1. The BAS shall monitor the status of the “on” and “cancel” buttons of the space temperature
   sensors. When an occupied bypass request is received from a space sensor, the unit shall
   transition from its current occupancy mode to occupied bypass mode and the unit shall
   maintain the space temperature to the occupied setpoints (adj.).

J. Economizer:
   1. The supply air sensor shall measures the dry bulb temperature of the air leaving the
   evaporator coil while economizing. When economizing is enabled and the unit is operating in
   the cooling mode, the economizer damper shall be modulated between its minimum position
   and 100% to maintain the discharge air temperature setpoint. The economizer damper shall
   modulate toward minimum position in the event the mixed air temperature falls below the low
   limit temperature setting. Compressors shall be delayed from operating until the economizer
   has opened to 100%.

   2. Reference Dry Bulb:
      a. Outside air (OA) temperature shall compared with a reference dry bulb setpoint. The
         economizer shall enable when the OA temperature is less than reference dry bulb
         setpoint. The economizer shall be disabled when OA temperature is greater than
         reference dry bulb setpoint + 5.0 deg. F.

K. Supply Fan:
   1. The supply fan shall be enabled while in the occupied mode and cycled on during the
   unoccupied mode. A differential pressure switch shall monitor the differential pressure
   across the fan. If the switch does not open within 40 seconds after a request for fan
   operation a fan failure alarm shall be annunciated at the BAS, the unit shall stop, requiring a
   manual reset.
L. Supply Duct Static Pressure Control:
   1. The unit controller shall modulate the supply fan output as required to maintain the duct static pressure setpoint. If the duct static pressure falls below the supply air static setpoint + deadband, the unit controller shall increase the output to the supply fan to maintain setpoint. If the duct static pressure rises above the supply air static setpoint + deadband, the unit controller shall decrease the output to the supply fan to maintain setpoint.

M. Building Pressure Control:
   1. The barometric relief dampers shall open with increased building pressure. As the building pressure increases, the pressure in the unit return section also increases, opening the dampers and relieving air.

N. Filter Status:
   1. A differential pressure switch shall monitor the differential pressure across the filter when the fan is running. If the switch closes for 2 minutes after a request for fan operation a dirty filter alarm shall be annunciated at the BAS.

O. Static pressure high limit:
   1. All safeties shall be hard wired to the supply and return fan starters or VFD safety circuits. Starters shall not function in the “Hand” or “Auto” and VFD’s shall be disabled if they are indexed to the “Auto” or “Hand” position in either the VFD or bypass modes.
   2. Supply Fan High Pressure Limit: Install a static pressure probe located in the air handling unit main discharge duct at least six feet or as far as physically possible downstream of the fan and upstream of any dampers and pipe to a differential pressure switch located in the temperature control panel. Wire in series with the safety circuit of the supply and return fan. Differential pressure switch shall be a manual reset type and the BAS system shall monitor the status of the differential pressure switch. Initial setpoint shall be +4.0” w.c. (adj.) (this setpoint should be set to 0.5” w.c. less than the pressure class of the ductwork)
   3. Supply Fan Low Pressure Limit: Install a static pressure probe located in the air handling unit immediately upstream of the prefilter and pipe to a differential pressure switch located in the temperature control panel. Wire in series with the safety circuit of the supply and return fans. Differential pressure switch shall be a manual reset type and the DDC system shall monitor the status of the differential pressure switch. Initial setpoint shall be -2.0” w.c. (adj.).

P. All points and alarms listed above shall be displayed graphically on BAS (including but not limited to).
   1. Discharge Air Temperature & Setpoint
   2. Outside Air Temperature
   3. Supply Duct Static Pressure & Setpoint
   4. Mixed air damper position
   5. Outside air damper position
   6. Modulating gas heat output
   7. Supply fan speed
   8. Supply fan status
   9. Cooling Stages output
   10. Heating/Cooling setpoints
   11. Occupied bypass timer
   12. Smoke status
13. Filter status
14. Supply Fan Static pressure high limit status
15. Supply Fan Static pressure low limit status
16. All alarms and points listed in above sequence.

3.05 PRESSURE INDEPENDENT VAV CONTROL

A. Control systems shall provide digital control for variable air volume terminal units.

B. Systems shall control pressure independent variable air volume terminal boxes serving individual zones. Systems shall be designed to provide variable air volume cooling with heating capabilities. VAV boxes shall be cooling with duct coil.

C. VAV box controller shall modulate damper and hot water reheat coil to maintain space setpoint of 72°F (adj.) with 2°F (adj.) dead band based on signal from wall mounted temperature sensor. Spaces with adjustable sensors will allow a ±3°F (adj.) offset from the BAS setpoint.
   1. Adjustable sensors may be enabled/disabled from BAS, coordinate with owner.
   2. See VAV box schedule for sensor types.

D. Provide temperature indication of air leaving VAV box.

E. VAV boxes with duct coil:
   1. When temperature is below setpoint of space sensor the VAV box will modulate to heating minimum air volume and then modulate reheat valve towards an open position. When temperatures are above setpoint, the opposite sequence will occur and boxes will modulate up towards a maximum air volume position as required.
   2. At full cooling, the VAV box shall be open to maximum cfm position. The reheat coil control valve shall be closed.
   3. Upon a fall in space temperature, the VAV box shall modulate closed until space setpoint is maintained, or until it reaches its minimum scheduled cfm position per the VAV box schedule. The reheat coil control valve shall be closed.
   4. For zones with perimeter radiation. Upon a further fall in space temperature, the fin-tube control valve shall modulate open to maintain space setpoint.
   5. Upon a further fall in space temperature, the reheat coil control valve shall modulate open to maintain space setpoint until the supply air temperature is 20°f (adj.) above room temperature setpoint.
   6. Upon a further fall in space temperature, VAV shall open to maintain setpoint until VAV airflow reaches its maximum heating setting. The reheat control valve shall continue to modulate open to maintain maximum delta t listed above.
   7. Upon a rise in space temperature, the reverse shall occur.
   8. The BAS shall utilize output from all VAV box positions to reset the supply duct differential static pressure.
      a. For VAV boxes in systems that use damper position in a static pressure set point reset optimization strategy, close the damper each day at midnight (adj.) to re-zero the damper position indicator, then reopen to last position and resume normal operation.
   9. Include the programming necessary to allow any VAV or group of VAV's to function with an “open-cooling minimum-heating cfm” control methodology if the space thermostat is not satisfied in the heating mode with the hot water valve 100% open. If the space thermostat is still not satisfied send a signal to the BAS control to increase the leaving hot water temperature from the heating system. The function shall be initially established for all perimeter spaces with the heating setpoint at 60%, although any VAV can be field programmed to function accordingly. Include all field programming required during warranty period.
10. When no hot water is available to reheat coils and space temperatures are equal to or below space sensor setpoint, the VAV box shall modulate to their cooling minimum air volume position. If the space temperature continues to drop below the space thermostat, send an alarm to activate the heating system. If space temperatures rise above setpoint, the VAV box will modulate towards a maximum air volume position as required.

11. HOT WATER COIL FREEZE PROTECTION: Monitor the discharge temperature of the RTU serving the VAV box and shut down the supply [and exhaust/relief] fans if the temperature falls below 40 °F (adjustable).

F. Zone Sensors

1. The zone sensor shall be accurate to within 0.5 F. The sensor shall be a product of the VAV box controls manufacturer and designed specifically for the installed controller.

2. The zone sensor shall have the following features:
   a. Zone setpoint adjustment
   b. Night setback temperature override button to provide occupied conditions during unoccupied times.

3. Night setback override cancel button to end the override condition.

4. OCCUPANCY SENSORS: Connect to occupancy sensor auxiliary contact (occupancy sensor provided under Division 26 Electrical) in all Classrooms/Offices/Conference as part of associated AHU. Whenever occupancy sensor indicates that the space is unoccupied during occupied mode, reset the minimum heating and cooling air volumes to zero and control to occupied standby temperature setpoints. Unoccupied space temperature shall be maintained at setpoint by duty cycling VAV box back to minimum air volumes for heating or cooling.

G. Unoccupied System:

1. The individual VAV box controller shall be automatically indexed to occupied/unoccupied control from the central processing unit. When indexed to unoccupied control, the VAV shall be capable of being returned to occupied control through thermostat. Provide the necessary hardware and software to permit any zone to be returned from unoccupied control to occupied control, overriding the central processing unit from a pushbutton or other signal at the zone thermostat. When an override to occupancy is required, local individually adjustable timer for each VAV controller shall be initiated with the system returning to occupied state at the end of the interval. Program as Owner required for designated groups of rooms.

2. Systems shall have individual adjustments for zone setpoint, (internal) dead band, heating/cooling proportional bank, setup/setback and minimum and maximum airflow. A velocity sensor measures airflow through the terminal unit and compares this value to the airflow control point. Based on these inputs, the controller shall adjust the outputs to the air valve motor to increase or decrease airflow as necessary. This allows the controller to provide pressure independent control, accommodating systems where fluctuations in duct static pressure would cause unwanted variations in airflow.

3. Systems shall use pressure transducers that measure velocity pressure at the terminal unit to control discharge CFM.

4. Systems shall provide an occupied mode to set-up the cooling setpoint and set back the heating setpoint during unoccupied periods.

5. System shall provide a shutdown mode that positions the damper actuator full closed and locks out any reheat functions. When space sensor calls for night operation, damper will open to maintain setback or setup temperatures as required.

6. VAV dampers shall be capable of tight shut-off when the space no longer requires heating or cooling to maintain the setback or setup temperatures as required.
7. Systems shall provide capability to adjust the zone setpoint at the zone sensor location or at the VAV controller.

H. The variable air volume units shall include the following components to be supplied under Section 23 36 00.
   1. Air valve with motor shaft for actuator operation (pneumatic or electric). Coordinate actuator type with this Section.
   2. Flow sensing ring.

I. Items furnished under this section:
   1. VAV hot water control valves shall be furnished under this section and installed under Section 23 36 00.
   2. Damper actuator.
   3. Control power transformer shall be provided and wired to circuits under this Section. Additional 20 amp dedicated branch circuits from panel to transformer for control of VAV boxes shall be provided. Verify connection locations at VAV boxes with box manufacturer. Wiring from transformer to VAV box controller shall be under this Section.
   4. VAV box damper/actuator control checkout shall be the responsibility of this section.
   5. Discharge temperature from VAV box shall be monitored by the BAS.

J. The Control Contractor shall be responsible for low voltage wiring of box digital controls. Wiring shall be in conduit or NEC plenum approved low voltage cable if ceiling is used for return plenum. Electrical power to VAV boxes shall be supplied under this section.

K. Alarm if space temperature is 10°F (adj.) above or below space temperature setpoint.

L. All points and alarms listed above shall be displayed graphically on BAS (including but not limited to).
   1. VAV box airflow
   2. Supply air temperature into box
   3. Discharge air temperature from box
   4. Hot water reheat valve position
   5. VAV damper position
   6. Space temperature
   7. Occupied/Unoccupied/Occupied Standby for Heating/Cooling temperature setpoints
   8. Min/Max Heating/Cooling airflow setpoints
   9. Occupied bypass timer
   10. Space temperature alarm
   11. All alarms and points listed in above sequence.

3.06 LIGHTING CONTROL

A. The existing lighting control panel shall be controlled by the building automation system. This contractor shall provide all wiring to BAS and provide all required programming.

B. Coordinate lighting control with electrical contractor and see electrical drawings for lighting control panel location.

C. Provide adjustable schedule for each zone for automatic operation. Provide on/off override from BAS.
D. All points and alarms listed above shall be displayed graphically on BAS (including but not limited to).
   1. Zone Lighting Status
   2. Zone Lighting On/Off
   3. Zone Lighting Schedule

3.07 TREND LOGGING

A. Long term historical trending for all applicable points on all systems shall be configured for commissioning efforts, installation and testing performance evaluations, and for the facilities long term use. Coordinate trend requirements with A/E and owner. Trend data shall be saved to the BAS network hard drive.

B. Program the trend logs at minimum:
   1. Air Handling Units
      a. Supply air flow CFM
      b. Outdoor air flow CFM
      c. Supply air temperature
      d. Supply air humidity
   2. Chilled Water System
      a. Chilled water supply temperature
      b. Chilled water return temperature
      c. Chilled water flow
      d. Chilled water BTU
   3. Heating Hot Water System
      a. Heating hot water supply temperature
      b. Heating hot water return temperature
      c. Heating hot water flow
      d. Heating hot water BTU
   4. Geothermal Water System
      a. Geothermal water supply temperature
      b. Geothermal water return temperature
      c. Geothermal water flow
      d. Geothermal water BTU
   5. Electrical Consumption
      a. Building Total Electrical Use
      b. Building Electrical Demand

3.08 WIRING

A. All electrical wiring in connection with automatic temperature control system here before described, shall be done as part of this Section.

B. All high voltage electrical wiring shall be installed in conduit, with separate fused circuits. Low voltage wiring, 24 volts or less, may be installed without conduit in concealed areas provided the voltage source is power and current limited as dictated by Codes. However, only wiring methods consisting of mineral insulated, metal-sheathed cable, type MC cable employing a smooth or impervious metal sheath without an overall nonmetallic covering, electrical metallic tubing, flexible metallic tubing, intermediate metal conduit or rigid metal conduit shall be installed in ducts or plenums used for environmental air.

C. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.
D. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be used in exterior locations and interior locations subject to moisture.

E. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

F. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.

G. All wiring done in connection with control equipment shall be installed to meet the requirements of National, State and Local Electrical Codes.

H. Provide complete wiring diagrams for all equipment and controls specified.

3.09 ADJUSTMENTS

A. Upon completion of the control work, completely adjust, ready for use, all sensors, valves, damper motors, electronic devices and relays, installed under this work.

B. Furnish to the owner a complete instruction manual covering the function, operation, and adjustment procedure for all control components, including "As Built" control drawings. Also provide 24 hours of personal instructions and training in operation of the system to the building operator(s) during the commissioning phase. After about 6 months after final completion, provide additional training as required (12 hours). The training hours on site shall not commence until the programming by the contractor is complete.

C. Demonstrate sequence of operation for commissioning purposes. Refer to Section 23 08 00, Commissioning of HVAC Systems.

D. Install within the Operation and Maintenance Manual, a copy of the "As-Built" control drawing(s) for the particular system (reduced if necessary). Include printed maintenance and lubrication schedule for equipment as applicable.
   1. Include a CD with a copy of the “As-Built” control drawings. Any necessary software to view the files on the CD shall be provided on the BAS computer.
   2. Part of the training instruction shall include a demonstration of using the software to view the CD.

E. Contractor shall maintain internet contact and be available to troubleshoot any problems during the two year warranty period. System acceptance shall not occur until computer is installed and operational, including graphics, and the operators have received their initial training.

3.10 POINT LIST

A. Provided by Control Contractor as part of the Shop Drawing submittal.

END OF SECTION 23 09 93
SECTION 23 21 10
PIPE AND PIPEFITTINGS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
B. The requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

A. Make pipe joints watertight, gastight, under pressures required for various services.
B. Under Materials, the ASTM or Federal Spec. numbers shall be the current ones in use, for pipe specified.

1.03 RELATED WORK

A. Refer to applicable Sections for type piping materials to be used with various systems.

1.04 SUBMITTALS

A. Submit in accord with Section 01 30 00.
   1. Descriptive product data describing all material furnished under Part 2 of this Section.

PART 2: PRODUCTS

2.01 PIPING

A. Steel pipe: Schedule 40 black, seamless, continuous welds, ASTM A-53.
B. Copper tubing: Type L, hard, ASTM B-88.

2.02 FITTINGS

A. Flex-seal couplings for similar and dissimilar pipe materials and sizes: sizes 1 1/4"-72", molded natural and synthetic rubber seal (ASTM C425 and ASTM C1173), 300 series stainless steel worm drive clamping bands (ASTM A240), as manufactured by Mission Rubber Company or Husky.
B. Malleable iron screw fittings: 150 psi black or galvanized, ANSI-B16.3.
C. Grooved fittings: Full flow with grooves or shoulders designed to accept Victaulic mechanical couplings. Standard fittings shall be cast of ductile iron conforming to ASTM A536, wrought steel ASTM A234 Grade WPB, factory-fabricated carbon steel, ASTM A53, Type E, F, or S, Grade B, galvanized when required, max water temp. +250°F (120°C).
   1. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
   2. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
   3. Anvil Gruvlok, Grinnell, Shurjoint, Tyco equals are acceptable.
D. Grooved couplings: Two piece ductile (ASTM A536)-iron cast housing. Gaskets for water service shall be “EPDM”, Grade “EHP” with dual color code rated to +250°F (120°C) or “E” with green color code maximum temperature +230°F (110°C), conforming to ASTM D2000. (Gaskets used in potable water services shall be UL classified in accordance with NSF-61.) Bolts and nuts shall be heat-treated carbon steel, track head, ASTM A449 and A183. Couplings shall comply with ASTM F1476, “Standard for the Performance of Fittings for use with Gasketed Mechanical Couplings in Piping Applications”.
1. Rigid Type: Coupling housings shall be cast with offsetting-angle-pattern bolt pads to provide joint rigidity and system support and hanging in accordance with ASME B31.1 and B31.9.
   a. 2” through 12”: Installation-Ready for direct stab installation with no loose components in the field, complete with grade EHP gasket, rated for water services to +250 degrees F. Victaulic Company Style 107H.
2. Flexible Type Couplings: For use in locations where vibration attenuation and stress relief are required. Victaulic Company Installation-Ready Style 177 and Style 77.
3. h14-Inches and Larger: Victaulic AGS couplings, consisting of two ductile iron housings with lead-in chamfer on the housing key, a wide-width FlushSeal gasket, and ASTM A449 zinc-electroplated steel bolts and nuts. Victaulic Company Style W07 (rigid type) or Style W77 (flexible type).
4. Anvil Gruvlok, Grinnell, Shurjoint, Tyco equals are acceptable.

E. Grooved fittings for copper systems: Full flow copper fittings with grooves designed to accept Victaulic grooved end couplings. Standard fittings shall be -wrought copper per ASME B16.22 and ASTM B-75 alloy C12200 and-bronze sand castings per ASME B16.18 and ASTM B-584-87 copper alloy CDA 844 (81-3-7-9). Fittings shall be manufactured to copper-tubing dimensions. (Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.) Victaulic Copper Connection.
1. Anvil Gruvlok, Grinnell, Shurjoint, Tyco equals are acceptable.

F. Grooved couplings for copper systems: Victaulic Style 607H, consisting of ductile iron housing conforming to ASTM A-536 (Grade 65-45-12) cast with offsetting angle-pattern bolt pads for joint rigidity with copper alkyd enamel paint coating, synthetic rubber gasket of a central cavity pressure-responsive design (conforming to copper tube size (CTS) O.D. and coupling housing and properties of ASTM D-2000. Gaskets for water service shall be EPDM, Grade “EHP” with dual color code rated to +250°F (120°C). ASTM A449 nuts and bolts to secure unit together. Installation-Ready for direct stab installation with no loose components in the field.-
1. Anvil Gruvlok, Grinnell, Shurjoint, Tyco equals are acceptable.

G. Grooved flanged connections for copper systems: Victaulic Style 641 Vic-Flange adapter. Casting and corresponding gasket same as for couplings.
1. Anvil Gruvlok, Grinnell, Shurjoint, Tyco equals are acceptable.

H. Rolled grooved pipe couplings: Grooved couplings and mechanical fittings shall be ductile iron, 500 PSI working pressure, in accordance with ASTM A536. Coupling gasket material shall be butal rubber. Grooved couplings and mechanical fittings shall be tested and listed by UL and/or FM.
1. Allied, Anvil Gruvlok, Grinnell, Tyco, Victaulic equals are acceptable.

I. Copper tube press water fittings: Viega ProPress copper or bronze fittings with “Smart Connect Feature”, for use on copper type K or L or M ½”-4” hard tubing or ½”-1 ¼” soft tubing, above ground installations, green dots, and EPDM rubber (black) 0-ring seal in the fitting socket, IAPMO IGC 137-99/PS 117-2000 and ANSI/NSF 61 approved, 0°F to 250°F operating temperature range, 200 psi maximum w.p., material complying with ANSI-ASME B16.18, B16.22, and ASTM B 88, seal complies with ASTM D 2000, 50-year warranty.
J. Copper tube press water fittings: Nibco Pressystem with wrought copper (ASTM B 75 Alloy C12200) & cast copper fittings (BS EN 1982:1999 modified Alloy CC491K), cast copper alloy press fittings shall be made from materials with a minimum of 78% copper and a maximum of 15% zinc, for use on copper type K or L or M, ½"-4" hard tubing or ½"-1 ¼" soft tubing, above ground installations, EPDM (BS EN 681-1) rubber (black) 0-ring seal in the fitting socket, ANSI/NSF 61 approved, -20°F to 250°F operating temperature range, 200 psi maximum w.p., flow area complying with ASME B16.22, fittings complying with ASME B16.22 and B16.18, 50-year warranty.

K. Copper tube press compressed air, natural & LP gas fittings: Viega ProPress G copper or bronze fittings with “Smart Connect Feature”, for use on copper type K or L ½"-4" hard tubing or ½"-1 ¼" soft tubing, above ground installations, yellow dots, and HNBR rubber (yellow) 0-ring seal in the fitting socket, IAPMO IGC 137-99/PS 117-2000 and ANSI/NSF 61 approved, -40°F to 150°F operating temperature range, 125 psi maximum w.p., material complies with ANSI-ASME B16.22, B16.18, and ASTM B 88, seal complies with ASTM D 2000, 50-year warranty.

L. Steel welding fittings: Schedule 40/80, ANSI-B16.9; ASTM A-234-WPB.


N. Bolting: Square head machine bolts with carbon steel semi-finished hex nuts.


2.03 UNIONS

A. Unions: Threaded malleable iron, 2 inch (DN50 mm) and under, FS WW-U-531.
   1. Black steel pipe, Type A.

B. Unions: Copper tubing:
   1. NIBCO copper to bronze 733.
      a. Use flux recommended by manufacturer.

C. Unions: Flanged steel over 2 inch (DN50 mm), ANSI-B16.1.

D. Unions and flanges for servicing and disconnect are not required in installations with grooved mechanical joint couplings. (The couplings shall serve as disconnect points.)

2.04 NIPPLES

A. Same material, composition and weight class as related pipe or tubing, except close nipples to be extra strong.

B. Threaded nipples, FS WW-N-351.

C. Welding nipples, steel, coped to fit pipe and with bevel ends.

2.05 FLANGE GASKETS

A. Steel flanges, "Cranite", ANSI-B-16.21.

B. Cast iron flanges, rubber, FS HH-G-156, Class A.
PART 3: EXECUTION

3.01 STEEL PIPING

A. Screw pipe: Cut square and ream, with thread end extending to shoulder of fitting, USAS-B2.1.
   1. Apply approved pipe joint compound to male threads, pipe cement and oil or graphite and oil.
   2. All pipe threads to be per ASME B1.20.1.

3.02 COPPER TUBING

A. Cut square, ream and apply flux to outside of tube and inside of fittings; heat joint until flux boils and apply solder to edge of fitting until entire joint is filled, wiping off excess solder, USAS-B.91.

B. Solder, ASTM B-32.
   1. 50-50 alloy for piping above floor.
   2. Use Sil-Fos for piping underfloor.
   3. Use 95-5 lead free solder and lead free flux all domestic water piping.

C. Mechanically formed tee fittings.
   1. As created by T-Drill.
   2. All joints created in this manner shall be installed (brazed) in compliance with code and the manufacturer's recommendations. Soft soldered joints shall not be permitted. The branch tube shall be notched and contain a double dimple. The first to insure proper penetration into the main line. The second dimple will serve as a visual inspection point.

D. Flared copper pipe: As recommended by manufacturer of fitting.

E. Copper tube press fittings: As recommended by manufacturer of fitting. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting insertion depth shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. Piping shall be installed in straight lines without “mis-alignments” at joints. Use only pressing tools and jaw sets that have been tested and authorized for use with the fittings. Deburr inside and outside of tubing prior to inserting into fittings.

3.03 WELDED PIPE JOINTS

A. Made by "qualified welders" using fusion process, embracing gas welding or electric arc welding procedures contained in "Standard Manual on Pipe Welding", ASME Code.

3.04 GROOVED FITTINGS AND COUPLINGS

A. Before assembly, properly apply a uniform thin coat of lubricant on gasket exterior including inside lip, pipe ends, and housing interiors, to prevent pinching the gasket. Use "Victaulic Lubricant" or other compatible materials such as silicone. Do not use petroleum based lubricants.

B. The coupling manufacturer's factory-trained representative shall provide on-site training for the contractor's field personnel in the proper use of grooving tools and installation of grooved joint products. The representative shall include field inspection during assembly and periodically visit the job site to ensure best practices in grooved joint installations are being followed. (A distributor's representative is not considered qualified to conduct the training.)

C. Pipe grooving shall be as recommended by manufacturer.
D. Do not use in conjunction with expansion joints.

E. The gaskets shall be suitable for the intended service, and shall be molded and produced by the coupling manufacturer. Maximum temperature +250 degrees F in sizes through 8”.

F. Include field inspection by manufacturer during assembly.

G. For applicable projects, the grooved coupling manufacturer shall provide inspection services and/or certify the installing contractor for the installation of their product. The manufacturer’s factory trained representative shall provide certification training for the installing contractor's field personnel in the use of grooving tools, application of groove, and product installation. The training program shall be designed, developed, administered and evaluated in accordance to the ANSI/IACET Standard for Continuing Education and Training. (IACET-International Association for Continuing Education and Training).

END OF SECTION 23 21 10
SECTION 23 21 11

VALVES AND COCKS: MANUAL

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS

A. Submit in accord with Section 01 30 00.

1. Descriptive product data describing all material furnished under Part 2 of this Section.

PART 2: PRODUCTS

2.01 BALL VALVES (1/2"-1")

A. Based on products by Jomar, Apollo.

B. 1/2" – 1" valves to have threaded or soldered ends.

C. Jomar 100 series valves, 100% lead tested, lifetime leak-proof stem, dezincification resistant brass alloy, triple sealing stem with Viton o-rings and Teflon seal, 600 WOG, blow out proof stem, meets NSF 372, 61-8 and 61 annex G standards, ANSI B1.20.1, wetted surface contains less than .25 lead content, accessories available.

D. Apollo 70 series valves; Adjustable stem packing gland, blow out proof stem design, chromium plated ball, 100% factory tested, maximum pressure 600 psi CWP, 150 psi SWP, max temperature 500F.

E. Apollo international valves will not be acceptable.

F. Provide 1-1/4" stem extensions on all hot water piping insulated with more than 1/2" thick insulation.

G. Provide 1-1/4" stem extensions on all insulated cold water piping.

1. Include a non-rotating sleeve with cap around the stem extensions on all insulated cold water piping to facilitate vapor barrier seal, similar to:

H. Contractor shall install bronze ball valves as specified and where shown on drawings. If brass ball valves are substituted and installed, the contractor will be required to replace each with as specified or to provide a credit of $150 for each valve substitution. A/E will discuss with the Owner and if acceptable will process a change order.

I. Contractor shall install ball valve stem extensions as specified. If not, the contractor will be required to install as specified or to provide a credit of $50 for the deletion of each valve stem extension. A/E will discuss with the Owner and if acceptable will process a change order.
2.02 BALL VALVE (1”-2”)

A. Based on products by Jomar, Appolo, Nibco.

B. 1 ¼” - 2” Valves shall have threaded ends unless otherwise indicated

C. Jomar 100 series valves, 100% lead tested, lifetime leak-proof stem, dezincification resistant brass alloy, triple sealing stem with Viton o-rings and Teflon seal, 500 WOG, blow out proof stem, meets NSF 372, 61-8 and 61 annex G standards, ANSI B1.20.1, wetted surface contains less than .25 lead content, accessories available.

D. Apollo 70 series valves; Adjustable stem packing gland, blow out proof stem design, chromium plated ball, 100% factory tested, maximum pressure 600 psi CWP, 150 psi SWP, max temperature 500F.

E. Apollo International valves will not be acceptable.

F. Provide 1-1/4” stem extensions on all hot water piping insulated with more than 1/2” thick insulation.

G. Provide 1-1/4” stem extensions on all insulated cold water piping.
   1. Include a non-rotating sleeve with cap around the stem extensions on all insulated cold water piping to facilitate vapor barrier seal, similar to:
      a. Apollo (-11) 2 ¼” “Thermal-Seal” insulating tee handle, or
      b. Nibco “NIB-SEAL” insulated-handle with equivalent ball valves, or
      c. Nibco “CS” extended lever handle.

H. Contractor shall install bronze ball valves as specified and where shown on drawings. If brass ball valves are substituted and installed, the contractor will be required to replace each with as specified or to provide a credit of $150 for each valve substitution. A/E will discuss with the Owner and if acceptable will process a change order.

I. Contractor shall install ball valve stem extensions as specified. If not, the contractor will be required to install as specified or to provide a credit of $50 for the deletion of each valve stem extension. A/E will discuss with the Owner and if acceptable will process a change order.

2.03 BALL VALVES (WATER) 2-1/2” AND LARGER

A. Use Butterfly Valves as specified below.

2.04 CAST IRON BUTTERFLY VALVES (WATER)

A. Based on product by Nibco.
   1. Anvil Gruvlok, Apollo, DeZurik, Mueller Steam Specialty and Victaulic equals, as acceptable.

B. Lug-wafer butterfly valves, 2-1/2” and larger, Nibco LC2000 with cast iron body, extended neck, molded in EPDM rubber body seal/liner, aluminum bronze disc, stainless steel stem, copper upper and lower bushings, brass collar bushing, EPDM rubber stem seal; lugs shall match number of holes in pipe flange.
   1. Disk to be bronze, aluminum-bronze, nickel plated ductile iron, cast iron with welded nickel edge, or 316 - stainless steel.
   2. Nylon coated ductile iron discs are not acceptable. Polymid or polyamide coated valves are not acceptable.

C. Valve assembly to be bi-directionally bubble tight to 200 psig with no downstream flange/pipe attached.
D. Wafer type butterfly valves, are not acceptable.

E. Provide ten (10) position lever-lock handle operator; valves 8" and larger, use worm gear operator.

F. Maximum pressure to be 200 psi.

G. Provide 1-3" stem extensions on all hot water piping insulated with more than 1/2" insulation thickness. Valve stem extensions shall allow operators to clear insulation without interference.

H. Provide 1-3" stem extensions on all insulated cold water piping.
   1. Include a non-rotating sleeve with cap around the stem extensions on all insulated cold water piping to facilitate vapor barrier seal, similar to:
      a. Milwaukee “XH” 2 ¼” stem extension with external plastic shield, or
      b. Nibco “NIB-SEAL” insulated-handle with equivalent ball valves, or
      c. Nibco “CS” extended lever handle.

2.05 BALANCING VALVES
A. Shall be Tour and Anderson.
   1. TA Series 78.

2.06 DRAIN VALVES
A. Use 3/4 inch ball valve (as specified above) with threaded hose adapter except strainer blowdown valves to be the same size as the blowdown connection.

B. Provide pressure rated hose cap, 150 PSIG @ 180°F, at each drain valve location. Jomar T-100HFG; Cap and chain for easy drain and hose connection, heavy steel chain, blow-out proof, Gland follower and single O-ring design.

PART 3: EXECUTION

3.01 VALVES (GENERAL USE)
A. Use ball/butterfly valves for isolating equipment or main/branch piping. Install valves as indicated, full size of piping.

B. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal position only where space limitations do not allow installation in an upright position or where large valves are provided with chain wheel operators. Where valves 2-1/2" and larger are located more than 12'-0" above mechanical room floors, install valve with stem in the horizontal position and provide a chain wheel operator. Valves installed with the stems down, will not be accepted.

C. Install swing check valves in the horizontal position, unless otherwise shown on drawings, with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.

D. Heating/Ventilating/Cooling:
   1. Install ball/butterfly, or globe valves on water connections, to isolate all hydronic equipment, coils and radiation.

E. Install stem extensions when shipped loose from valve.

F. Prior to flushing of piping systems, place all valves in the full-open position
3.02 BALL VALVES

A. Piping and valve on cold water piping up to and including the non-rotating sleeve shall be insulated and sealed with vapor barrier mastic.

3.03 DRAIN VALVES

A. Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping systems, equipment locations specified or detailed including reheat coils and all strainer locations, other locations required for drainage of systems.

END OF SECTION 23 21 11
SECTION 23 21 12

PIPING SPECIALTIES

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS

A. Submit in accord with Section 01 30 00.
   1. Descriptive product data describing all material furnished under Part 2 of this Section.

PART 2: PRODUCTS

2.01 STRAINERS (GENERAL USE)

A. Based on products by Mueller Steam Specialty “Muessco” or Titan FCI.
   1. Armstrong, Grinnell, Keckley, Metra-Flex, Mueller "Muessco", Nibco, Sarco, Titan FCI, Gruvlok and Vitaulic equals are acceptable.

B. Strainer, 3" and smaller, Mueller Steam specialty 11, Titan FCI YS12, 250#, iron body, screwed.

C. Strainer, 2" and larger, Mueller Steam specialty 758, Titan FCI YS58, iron body, flanged, 125#.

D. Screens, stainless steel cylinder roll.

E. Refer to strainers, Section 23 21 16 "Water Specialties - Hot/Chilled" and Section

2.02 DIGITAL THERMOMETERS

A. Based on product by Trerice.

B. Trerice SX9 “Solar Therm” digital adjustable angle thermometer light powered, within 1% accuracy, cast aluminum NEMA 4X/IP65, range of -40-300°F, 3/8” LCD digits, internal potentiometer, 10 Lux (one foot-candle rating), 10 second updates, ambient operating temperature of -30-140°F, glass passivated thermistor sensor, fully interchangeable with industrial glass thermometers, with E35-75BS ¾” NPT 6” socket.

C. Include brass wells for installing in piping.

2.03 PRESSURE GAUGES

A. Based on product by Trerice.
   1. Ashcroft, Marsh, U.S. Gauge, Weiss, Weksler or Winters equals are acceptable.

B. Trerice 600CB Series gauge with 4 ½” dial, brass tube and socket, brass movement, black adjustable pointer, cast aluminum case with black finish, stem mounted, flangeless, aluminum dialface with white background and black figures; range - 125% of working pressure; normal operation to be mid-scale.
C. Use snubbers on gauges with large pressure variations or subject to vibration.

D. Gauge valves: Trrice 735-2, 1/4 inch NPT female connections, brass bar stock needle valve; 2,000 PSI and 300°F (minimum).

2.04 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

A. Brass plug with 1/4" NPT threads, EPDM or neoprene valve core, knurled cap with cap strap. Use extended length plugs to clear insulated piping. Adaptors shall have 1/4" FPT connection for standard pressure gauges.

2.05 HOSE CONNECTION CAPS

A. Hose connection caps shall be pressure rated for 150 psig at 180 deg F.

PART 3: EXECUTION

3.01 STRAINERS

A. Install ahead of pumps, (not required if strainer is at rolairtrol), pressure reducing stations, steam traps (except thermostatic), and other equipment (where indicated); arrange so strainer is accessible and removable.

B. Provide extension leg with drain valve and pressure rated hose connection cap, as specified above.

C. For hot water heating systems, use coarse mesh screen (approx. 1/8 inch). When pumps are provided with suction diffusers, strainers are not required.

3.02 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

A. Install in piping systems as indicated on the drawings and/or details. Do not insulate over test plugs.

3.03 THERMOMETERS AND GAUGES

A. Thermometers and gauges shall be installed so they are easily read, not more than 8 feet above floor. Where necessary, provide armored capillary bulb and remote dial gauge or thermometer.

B. Provide socket and stem lengths as required. Do not adversely restrict water flow in piping; install insertion socket in tee, where possible.

C. Use gauge valves where gauge stops or gauge cocks are indicated.

D. Use gauge snubbers to reduce vibration for gauges used on pumps and air compressors.

END OF SECTION 23 21 12
SECTION 23 21 13
PIPING SUPPORT DEVICES

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

B. The requirements of Section 23 05 00 apply to this Section.

1.02 RELATED WORK

A. Piping: Section 23 21 10.

B. Vibration Isolation Hangers: Section 23 05 48.

C. Metal Insulation Protection Shields: Section 23 07 19.

1.03 SUBMITTALS

A. Submit in accord with Section 01 30 00.
   1. Descriptive product data describing all material furnished under Part 2 of this Section.

1.04 REFERENCES


B. ASTM A123 - Standard for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip.


PART 2: PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Based on products by B-Line Systems.
   1. Anvil International, Anvil Strut, Hilti, Michigan, Unistrut, Hubbard Enterprises/Holdrite equals are acceptable.

B. Individual pipe attachments shall conform to the following:
   1. Steel Pipe:
      a. B-Line B3100 standard steel clevis hanger (½" - 30").
      b. B-Line B3104 carbon steel light-duty clevis hanger (3/8" - 4").
      c. B-Line B3170 pre-galvanized carbon steel adjustable swivel ring band hanger (2 ½" - 8").
      d. B-Line B3170NF pre-galvanized steel adjustable swivel ring band hanger (½"-8").
e. B-Line B3171 malleable iron adjustable swivel ring hanger (½" - 8").
f. B-Line B3172 carbon steel adjustable band hanger (½" - 8").
g. B-Line B3173 malleable iron split ring hanger (3/8" - 8") with B3222 malleable iron eye socket.
h. B-Line B3198H malleable iron hinged extension split pipe clamp hanger (3/8 - 3").
i. B-Line B3198R malleable iron extension split pipe clamp hanger (3/8 - 4").
j. B-Line B3690 carbon steel adjustable "J" hanger (½" - 8").

2. Copper Tubing:
   a. B-Line B3104CT dura copper coated carbon steel clevis hanger (3/8" - 4").
   b. B-Line B3170CT dura copper steel adjustable swivel ring band hanger (½" - 6").
   c. B-Line B3172CT copper coated steel adjustable ring band hanger (½" - 4").
   d. B-Line B3173CT copper coated malleable iron split ring hanger (3/8" - 4") with B3222 malleable iron eye socket.
   e. B-Line B3198HCT dura copper malleable iron hinged extension split pipe clamp hanger (3/8 - 3").
   f. B-Line B3198RCT dura copper malleable iron extension split pipe clamp hanger (3/8 - 4").

3. Horizontal Clamp: B-Line B3144 carbon steel double bolt pipe clamp with plain finish (1 ½" - 24").

C. Where thermal expansion in excess of ½" is anticipated (generally straight heating main runs exceeding 50 feet in length), and with all piping 6 inch diameter or larger, use B-Line B3114 carbon steel axle with cast iron roller/malleable sockets (2" - 30") or B-Line B3110 adjustable carbon steel yoke with cast iron roller (2" - 20") or B-Line B3120 carbon steel roller chair with cast iron roller (2" - 12").

D. B-Line bolted metal framing support system consisting of channel, fittings, hardware and/or threaded hanger rods (with inserts, beam clamps, pipe clamps and pipe rollers similar to items specified above), modified as follows:
   1. For supporting un-insulated copper tube to strut, use B-Line B2000 series epoxy painted pipe straps sized for copper tubing, or B-Line BVT series plastic inserted vibration isolation clamps.
   2. For supporting insulated piping to strut, use B-Line Armafix IPH Series insert and clamp assembly unless the specified insulation can be undisturbed and insulation protection shields used. Pipe clamps/straps to be used as needed for alignment of piping on trapeze supports and to secure piping installed along walls. Insulation shall not be cut, notched, or otherwise damaged at support locations and shall maintain vapor barrier jacketing.
   3. Armafix IPH Series insert and clamp assembly shall be installed by respective mechanical trade, prior to pipe insulation.

E. B-Line Armafix IPH Series insert and clamp assembly (Buckaroo equals are acceptable). ½", ¾", & 1" Armaflex insulation thickness, ½" - 8" pipe sizes, painted aluminum jacket, CFC-free PUR/PIP supports, self-adhesive closure. Materials shall have a flame-spread index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.

F. Wall supports:
   2. B-Line B3066 welded carbon steel medium duty angle bracket with B3110 or B3120 roller supports.
   3. B-Line B3067 welded carbon steel heavy-duty angle bracket with B3110 or B3120 roller supports.
   4. B-Line B3190 carbon steel offset J-Hook (½" - 4").
   5. B-Line B3191 carbon steel straight J-Hook (½" - 4").
   6. B-Line B3690 carbon steel adjustable "J" hanger (½" - 8").
G. Vertical supports:
   1. B-Line B3373 standard carbon steel riser clamp (½” - 30”).
   2. B-Line B3373CT dura copper coated carbon steel riser clamp (½” - 4”).
   3. Clamp shall be sized to fit outside diameter of pipe.

H. Pipe covering protection saddles, B-Line B3160-3/4” through B3165-36 (¾” - 36”), carbon steel with plain finish.
   1. Use saddles with all roller type supports or hangers.
   2. Refer to Section 23 07 19 for pipe covering protection shields.

PART 3: EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

A. Individual pipe hangers shall be furnished for each respective mechanical piping system; trapeze type supports for grouped piping runs may be coordinated among Piping Contractors.

B. Pipe hangers shall be rated for the load to be carried. Where loads are excessive, furnish heavier duty equipment or reduce spacing. Include all supplemental angles, channels, plates, etc. of adequate sizes and design, where supports shall be required between building structural members.

C. Hangers shall be arranged as not to cause undue strain, located near or at change in direction and at concentrated loads. They shall provide vertical adjustment to maintain proper pitch and shall allow for expansion and contraction in the piping. Hangers shall be fastened to building steel members wherever practical.

D. No dissimilar support shall come in contact with copper tubing; use epoxy painted finish on all hangers and clamps (B-Line “Dura-Copper”). The epoxy painted finish provides corrosion protection and protects from dissimilar metal contact. With the epoxy painted finish, it is not necessary to isolate the clamp, hanger, or trapeze from the tubing.

E. Horizontal steel pipe shall be supported as below:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>ROD DIAMETER</th>
<th>MAXIMUM SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Up thru 1 1/4 inch</td>
<td>3/8 inch</td>
<td>7 feet</td>
</tr>
<tr>
<td>2. 1 1/2 inch</td>
<td>3/8 inch</td>
<td>9 feet</td>
</tr>
<tr>
<td>3. 2 inch</td>
<td>3/8 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>4. 2-1/2 inch</td>
<td>1/2 inch</td>
<td>11 feet</td>
</tr>
<tr>
<td>5. 3 inch</td>
<td>1/2 inch</td>
<td>12 feet</td>
</tr>
<tr>
<td>6. 4 and 5 inch</td>
<td>5/8 inch</td>
<td>12 feet</td>
</tr>
<tr>
<td>7. 6 inch and 8 inch</td>
<td>3/4 inch</td>
<td>12 feet</td>
</tr>
</tbody>
</table>

F. Horizontal lines of copper tubing shall be supported as below:

<table>
<thead>
<tr>
<th>NOM. TUBING SIZE</th>
<th>ROD DIAMETER</th>
<th>MAXIMUM SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Up thru 3/4 inch</td>
<td>3/8 inch</td>
<td>5 feet</td>
</tr>
<tr>
<td>2. 1 and 1-1/4 inch</td>
<td>3/8 inch</td>
<td>6 feet</td>
</tr>
<tr>
<td>3. 1-1/2 and 2 inch</td>
<td>3/8 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>4. 3 inch</td>
<td>1/2 inch</td>
<td>10 feet</td>
</tr>
</tbody>
</table>

G. Support vertical cast iron and copper risers at base and secured at every floor; support vertical steel risers at every other floor.
H. Structural attachments shall be as hereafter specified.
   1. Attach to concrete using B-Line B2500 light weight concrete insert for loads up to 400 pounds and B-Line B3014 universal insert for loads up to 1,140 pounds.
   2. Attach to steel beams using B-Line B3050 malleable iron I-beam clamp for piping 6 inch diameter or less.

I. Where inserts are omitted, use two (2) Phillips expansion shields with B-Line channel, for each hanger.

J. Continuous threaded rods shall be used wherever possible and shall be zinc plated, except above suspended ceilings.

K. No wood supports will be allowed. Do not pierce ducts with hanger rods.

L. Ductwork shall not be used to support piping.

M. Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.

N. Hangers and strut located in corrosive areas shall be type 304 stainless steel with stainless steel hardware.

3.02 STRUT PIPE SUPPORT CLAMP INSERTS

A. Provide Armafix® inserts with clamps on all insulated hot and cold water piping clamped to strut systems or other pipe support systems to prevent compression of insulation, to maintain insulation thermal properties, to maintain vapor barrier, and prevent condensation on piping and supports. All joints shall be sealed with Armaflex 520 adhesive. Friction insulation tape shall be used to position Armafix® inserts to help prevent insert from slipping out of the support due to thermal expansion and contraction.

3.03 PLASTIC PIPE SUPPORTS

A. Horizontal PVC piping (polyvinyl chloride) shall be supported on plastic supports and hangers or on steel padded split ring or clevis hangers.

B. Support vertical plastic risers at each floor.

C. Do not clamp plastic piping too tightly.

D. Plastic piping shall be free to move sideways; installation should not be rigid.

E. Conform to manufacturer's latest support recommendations. However, the above support spacing shall not be exceeded unless the Contractor obtains "Wisconsin Department of Commerce" approval to do so.

END OF SECTION 23 21 13
SECTION 23 21 14
HOT WATER HEATING SYSTEM

PART 1: GENERAL

1.01 RELATED DOCUMENTS
   A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
   B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS
   A. Submit in accord with Section 01 30 00.
      1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.

PART 2: PRODUCTS

2.01 HOT WATER HEATING PIPING
   A. Above ground: Refer to Section 23 21 10 Pipe and Pipe Fittings for pipe material types. Black steel (Schedule 40), with 125 psi continuous weld through 2 inch or 150 psi seamless weld for all sizes; or 125 psi cast iron or 150 psi malleable iron screw fittings, or grooved fittings (230°F. max.).
   B. Above ground: At Contractor's option, Type L (Hard) copper with wrought copper fittings.

PART 3: EXECUTION

3.01 PIPING
   A. All steel piping 2 inch and larger (above floor), may be screwed or welded. Steel piping 2 inch and smaller may be butt welded or screwed. Underground steel piping shall be welded.
   B. Seamless welding fittings (elbows, tees, reducers, flanges, etc.) shall be used for all welded piping except that welding nipples (Weldolets, Threadolets or Pipe-o-Lets, 250# maximum w.p.) may be used for branch take-offs up to one-half (1/2) the diameter of the main.
   C. If copper piping is used, mechanically formed tee connections may be provided in lieu of wrought copper fittings. Joints shall be brazed using Sil Fos. System shall have BOCA Code approvals and shall be submitted for written approval by A/E.
   D. Pipe to be straight, true and free of defects - full lengths of pipe shall be used; short lengths welded or coupled together will not be permitted.
   E. Piping shall be arranged to permit free expansion and contraction without injuring the connections. Pipe anchors, expansion loops, etc. shall be installed where required. Sleeves for risers from underfloor piping shall be oversized by 1 inch to allow for expansion. Underfloor piping shall be installed at least 6 inches below underside of floor slab.
   F. Double swing joints shall be provided at piping branches to equipment, except that piping concealed in steel joists, suspended ceilings and underground, may have branches constructed of “Soft” copper piping without swing joints, where copper piping is used.
   G. Use insulators where copper piping rests on steel.
   H. Branches to up feed risers shall be taken off top of main with tee and 45° ell. Laterals to downfeed radiation to be taken off bottom of main.
I. Up feed radiation shall be provided with manual air vents at high points. All high points in piping shall have manual air vents, accessible through panels, when required. Where possible, pitch piping up in direction of flow.

J. Provide drains at all low points. Piping shall be so arranged to enable the entire system to be drained.

K. Copper vertical radiation connections, where exposed between floor and unit, to be straight hard pipe.

L. Install a balancing cock on all radiation, at all circuit returns as they enter a common return and at other points indicated on Working Drawings.

M. Provide unions in all piping, at connections to equipment.

N. Use reducing fittings at all changes in pipe size; bushings are not permitted.

O. Temperature control valves, bulbs, flow switches and other accessories furnished under Controls or other Sections will be installed in piping under this Section.

P. Where control valves are installed that are smaller than line size, piping may be reduced to valve size for a maximum of 2 feet on either side of control valve.

Q. Fill all openings in walls, floors and ceilings between piping and sleeves, with non-combustible material, where heating piping passes out of boiler and equipment rooms, or through fire-rated walls and floors.

3.02 INITIAL SYSTEM FILL

A. When initially filling the system for testing and cleaning, attach a temporary water meter to record the volume of the system. This record shall be included in the Operation and Maintenance Manual.

3.03 SYSTEM/CLEANING

A. The entire new hot water system shall be initially cleaned using the following procedure in sequence:

   1. Hydraulically flush entire new system to remove construction debris.
   2. Dissolve oil and greases by adding to the system a low sudsing alkaline cleaning formulation in the proper portion. This solution is to be circulated at an elevated temperature of from 180°F to 200°F for a period of six hours, followed with a thorough rinse of the system.
   3. Remove mill scale by circulating solution of citric acid equivalent to 3% of system volume for from three hours at a temperature of 160°F to 200°F. Follow this with a thorough alkaline rinse to neutralize all areas.
   4. Remove and clean all strainers in the system.
   5. Refill system with fresh water.

3.04 GLYCOL SYSTEM

A. HEATING WATER SYSTEM (BURST PROTECTION)

   1. Fill system with a premixed 30% Industrially Inhibited Propylene Glycol solution formulated for use in hydronic systems. Fluid to be diluted with distilled or deionized water only and dyed to facilitate leak detection. Design based on DOWFROST, equal products by Interstate, Rhomar Water and Thermal Charge are acceptable.
2. Concentrations of glycol solution shall be sent to Dow Chemical Company for lab testing to prove a minimum of –20°F “burst” protection and correct inhibitor levels. Lab test results shall be submitted to Owner and Engineer prior to Substantial Completion. Lab test results shall be included with piping test reports.

B. Automotive grade glycols shall not be used in the heating system.

END OF SECTION 23 21 14
SECTION 23 21 16
WATER SPECIALTIES-HOT/CHILLED

PART 1: GENERAL

1.01 RELATED DOCUMENTS
   A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
   B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS
   A. Submit in accord with Section 01 30 00.
      1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.

PART 2: PRODUCTS

2.01 BALANCING STATIONS
   A. Based on product by Victaulic, Tour & Anderson (circuit setter).
   B. Valves 1/2" to 3" pipe size to be of bronze body/brass ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT insert and check valve. Valve bodies to have 1/4" NPT tapped drain/purge port. Valves to have Memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. Valves to have calibrated name plate to assure specific valve settings. Valves to be leak-tight at full rated working pressure.
   C. Valves shall be provided with molded insulation to permit access for balance and read-out.
   D. Valves shall be designed for a minimum 125 psig at 250 degrees F.

2.02 SYSTEM AIR VENTS
   A. Manual Ball Valve Vents
      1. Provide 1/4" ball valves for manual venting of VAV unit coils and where indicated elsewhere on drawings and details. Reference specifications Section 23 21 11.

PART 3: EXECUTION

3.01 BALANCING STATIONS
   A. Install where indicated on Working Drawings. Provide tight shut-off balancing valve in conjunction with balancing device.
3.02 SYSTEM AIR VENTS

A. MANUAL BALL VALVE VENTS:

1. Install on air handling coils and where indicated elsewhere as shown on drawings and details.

END OF SECTION 23 21 16
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Project drawings, related applicable specification sections, and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:
   1. HVAC water-treatment chemicals.
   2. Glycol concentration percentages indicated in this section shall be provided regardless of glycol concentration percentages indicated on mechanical equipment schedules.
   3. Glycol shall be added to the hydronic Chilled water piping system including all new and existing piping.
   4. All glycol system fill and filtration equipment.

B. Water from the project site shall not be utilized. Water shall be premixed to the required solution concentrations for the Hydronic Chilled Water shall be delivered via 55 gallon drums. Water shall also be mixed, adjusted, and tested to the performance requirements indicated in these specifications before introduction into the piping systems.

C. WELDER COOLING SYSTEM (QUANTITY OF 2)
   1. Existing welder cooling system shall be relocated in project. This section shall provide chemical treatment as recommended for system.

1.3 APPROVED PROVIDERS

A. This section of work shall be provided by Wisconsin Mechanical.
   1. Contact Jim Kent at 715-834-7676 for pricing.
   2. Not alternate vendors allowed.

1.4 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Hydronic chilled water systems shall be filled with glycol solutions to insure bursting protection to \(-20\) deg F and in the percentages listed below.

C. Provide water treatment and corrosion inhibitors for the Chilled Water System to maintain the water quality below.

D. Glycol types and concentrations:
   1. 30% Propylene Glycol / 70% water solution in the Hydronic Chilled Water System.

E. Closed hydronic systems, including hot-water heating and chilled water cooling, shall have the following water qualities:
   1. pH: Maintain a value within 8.0 to 9.0
   2. CaCO3 Alkalinity: Maintain a value within 100 to 500 mg/l
   3. CaCO3 Harness: Maintain a value within 100 to 500 mg/l
   4. Inhibitors: Maintain a phosphate value of 1,500-3,000 ppm.
   5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. Total Iron: Maintain a maximum of 5 mg/l
7. Ammonia: Maintain a level less than 2.0 mg/l
8. Chlorides: Maintain a level less than 200 mg/l
9. Dissolved Solids: Maintain a level less than 1000 mg/l
10. Manganese: Maintain a level less than 0.4 mg/l
11. Nitrate: Maintain a level less than 100 mg/l
12. Sulfate: Maintain a level less than 200 mg/l
13. Microbiological Limits:
   a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
   b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
   c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
   d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
   e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
   f. Legionella: Maximum of 0 organisms/ml.
14. The water shall be mixed, treated, and tested to meet these requirements before shipment to site.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
   1. Side stream Filters.
   2. Glycol fill pumps.
   3. Chemical material safety data sheets.
   4. Glycol.

1.6 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dowfrost Propylene Glycol – Hot Water Systems

2.2 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

B. Cleaning Chemicals:
   1. Per the HVAC treatment contractor.

C. Corrosion Inhibitors:
   1. Glycol shall have phosphate and corrosion inhibitors integral to glycol.
PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Water from the project site shall not be utilized. Water shall be premixed to the required solution concentrations for the Hydronic Chilled Water Systems. Water shall also be mixed, adjusted, and tested to the performance requirements indicated in these specifications before introduction into the piping systems.

3.2 INSTALLATION REQUIREMENTS

A. Systems: Assist install of the following glycol solutions into the hydronic systems.
   1. 30% Propylene Glycol / 70% water solution in the Hydronic Chilled Water System.

B. Deliver chemical application equipment and chemicals to site, Oversee and facilitate all chemical installation, which will be installed by Section “Hydronic Piping”.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
   2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
   3. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   4. Leave uncovered and unceoncealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   5. Cap and subject piping to static water pressure of 75 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
   6. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Remove and replace malfunctioning units and retest as specified above.

D. Sample hot water heating and chilled water system water at two-week intervals after boiler startup for a period of eight weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic.
   1. Add additional chemicals as required to meet the performance characteristics.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 23 25 00
SECTION 23 31 00

DUCTWORK

PART 1: GENERAL

1.01 RELATED DOCUMENTS
A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
B. The requirements of Section 23 05 00 apply to this Section.
C. See Section 23 37 16 Fabric Ductwork.

1.02 REFERENCE STANDARDS
A. ANSI/ASTM B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B. ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
C. ASTM A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
D. ASTM A525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
E. ASTM A527 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
F. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
G. UL 181 Standard for Safety for Factory-Made Air Ducts and Air Connectors
H. UL 181 B-M Standard for Safety for Duct Sealant for Flexible Ductwork
I. UL 723 Standard for Safety for Surface Burning Characteristics of Building Materials

1.03 SUBMITTALS
A. Submit in accord with Section 01 30 00.
   1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.
      a) Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
      b) Duct sealant and gasket material.
      c) Instructions for proper backfilling and precautions.

1.04 DESIGN CRITERIA
A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.
B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:
   • HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005
   • Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004
• HVAC Phenolic Duct Construction Standards

C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

PART 2: PRODUCTS

2.01 GENERAL

A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.

B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

C. All materials for ductwork, securing methods, hangers, etc. shall be of approved materials that are compatible with the ductwork and that will not promote galvanic action.

2.02 LOW PRESSURE SHEETMETAL DUCTWORK

A. 1800 FPM maximum velocity, 2" W.C. maximum duct static pressure.

B. Sheet metal ducts shall be constructed of standard galvanized steel (iron) sheets of sizes indicated on working drawings.

C. Where specified, aluminum "utility sheet" ductwork shall be used.

D. Low velocity ductwork shall be of materials and construction outlined in the latest edition of the SMACNA Duct Manual "Low Pressure Duct Construction Standards" or ASHRAE Guide chapters "Duct Design" and "Duct Construction".

E. Materials

1. Galvanized Steel Sheet:
   a) Use ASTM A525 or ASTM A527 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90.

2. Aluminum Sheet:
   a) Use ANSI/ASTM B209 aluminum sheet, alloy 3003H-14, capable of double seaming without fracture.

F. All couplings shall be slip-joint construction with a minimum 2 inches insertion length. Seal all couplings with sealants as specified.

G. Sheet metal used shall not be lighter than the following gauges; unless conforming to above standards for reinforcing and spacing.

<table>
<thead>
<tr>
<th>Round Ducts</th>
<th>U.S. Std. Gauge</th>
<th>Rectangular Ducts</th>
<th>B.&amp;S. Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>26</td>
<td>1-12 inches</td>
<td>0.020</td>
</tr>
<tr>
<td>1-10 inches</td>
<td>24</td>
<td>13-30 inches</td>
<td>0.025</td>
</tr>
<tr>
<td>11-20 inches</td>
<td>22</td>
<td>31-54 inches</td>
<td>0.032</td>
</tr>
<tr>
<td>21-40 inches</td>
<td>20</td>
<td>55-84 inches</td>
<td>0.040</td>
</tr>
<tr>
<td>41-60 inches</td>
<td>18</td>
<td>85-96 inches</td>
<td>0.051</td>
</tr>
<tr>
<td>Kitchen range hood 16 or 18 S.S.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

H. Round low velocity ducts may be spiral seam construction as manufactured by Semco or United Sheet Metal. Spirally wound metal ducts shall be constructed to provide structural strength equal to rectangular ducts. The metal may be one standard gauge lighter than required for round ducts.

I. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations.
J. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use riveted construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.

K. Use stamped or welded 5-gore (minimum) elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular mitered elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable. Pleated or adjustable elbows not allowed.

L. Where rectangular mitered elbows are used, provide turning vanes in accordance with Section 23 33 00.

M. Provide flanged high efficiency take-offs (See Section 23 33 00) or flanged conical fittings for round branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.

N. Button punch snaplock construction will not be accepted on aluminum ductwork.

O. Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts.


2. For duct construction pressure 2” w.g. or below and 12” diameter or less:
   a) Round low velocity ductwork shall be self-locking, presealed snaplock pipe which incorporates a factory applied E.P.D.M. gasket on the longitudinal and transverse joints. Snaplock pipe shall be “Greenseam +” as manufactured by Ductmate Industries or approved equal.
   b) All other round duct sizes shall be spiral lock construction.

P. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.03 MEDIUM/HIGH PRESSURE SHEETMETAL DUCTWORK

A. Above 1800 FPM velocity, 3” W.C. and over static pressure.

B. Medium to high pressure air systems shall be of materials and construction outlined in the latest edition of SMACNA Duct Manual "High Pressure Duct Construction Standards" or ASHRAE Guide chapters "Duct Design" and "Duct Construction".

C. Medium pressure ductwork shall be factory fabricated, single wall spiral seam construction for round or flat oval ducts. Construct all high pressure ducts in accordance with SMACNA pressure classification equal to 150% of scheduled static pressure for system fan.

1. Based on product by United Sheet Metal "Uniseal Duct" and "Uniform Fittings".
   a) Equal products by Ajax, Eastern Sheet Metal, Fab Duct, Lindab, Semco, Sheet Metal Connectors, Snyder, SVEE Metalworks and Tangent equals are acceptable.
D. All round duct through 60" in diameter shall be manufactured from galvanized steel meeting the ASTM A-527-71 in the following gauges:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 14&quot;</td>
<td>26</td>
</tr>
<tr>
<td>15 - 26&quot;</td>
<td>24</td>
</tr>
<tr>
<td>27 - 36&quot;</td>
<td>22</td>
</tr>
<tr>
<td>37 - 50&quot;</td>
<td>20</td>
</tr>
<tr>
<td>51 - 60&quot;</td>
<td>18</td>
</tr>
</tbody>
</table>

1. Spiral duct shall be supplied 12' lengths for accurate fit-up by field cutting.
2. All round duct through 60" diameter shall be spiral lockseam construction.
3. All round duct 61" diameter and over shall be welded joint construction from 16 gauge galvanized steel.
4. All fittings and couplings shall be manufactured from galvanized steel meeting ASTM A-527-71 with continuous welds in the following gauges:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 8&quot;</td>
<td>22</td>
</tr>
<tr>
<td>9 - 36&quot;</td>
<td>20</td>
</tr>
<tr>
<td>37 - 50&quot;</td>
<td>18</td>
</tr>
<tr>
<td>51&quot; &amp; Over</td>
<td>16</td>
</tr>
</tbody>
</table>

E. All flat-oval duct and fittings shall be manufactured from galvanized steel meeting the ASTM A-527-67. Duct shall be fabricated through 20" minor axis with longitudinal seam duct for minor axis of 22" or larger.

1. All fittings shall be manufactured with continuous weld.
2. Duct and fittings shall conform to the following gauges (width based on major duct axis):

<table>
<thead>
<tr>
<th>Flat Oval</th>
<th>Gauge</th>
<th>Longitudinal Seam</th>
<th>Gauge</th>
<th>Fittings</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>To 24&quot; Incl.</td>
<td>24</td>
<td>To 36&quot; Incl.</td>
<td>20</td>
<td>To 36&quot; Incl.</td>
<td>20</td>
</tr>
<tr>
<td>25-48&quot; Incl.</td>
<td>22</td>
<td>37-50&quot; Incl.</td>
<td>18</td>
<td>37-50&quot; Incl.</td>
<td>18</td>
</tr>
<tr>
<td>49-70&quot; Incl.</td>
<td>20</td>
<td>51&quot; and Up</td>
<td>16</td>
<td>51&quot; and Up</td>
<td>16</td>
</tr>
<tr>
<td>71&quot; and Up</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F. Joints shall be sealed with Tuff-Bond #12 sealant made by DuroDyne, Ductmate, Goodie E. Moore, Hardcast, Semco or United duct sealer. Sealant shall be applied in strict accordance with manufacturer's instructions and shall be applied to mating surface assembly. Use cemented slip joints with 4 inch minimum overlap, flanged connections, or welded/brazed connections, unless noted otherwise for special applications. Prime coat welded joints. Application of sealant over finished joint is not acceptable. Cover all joints with duct tape after the joints have been sealed. Sealant shall meet requirements of UL 723 for sheet metal ducts and UL 181 B-M for flexible ductwork.

G. All 90 degree taps shall be flanged conical or flanged high efficiency take-offs rated for duct system pressure installed; all 45 degree laterals shall be straight; all rectangular taps shall be 45 degree entry fittings; straight taps or bullhead tees are not acceptable. Secure all fittings suitably for pressure class 4" w.c. and over. Additional mechanical fasteners are required for pressure class 4" w.c. and over.
H. Internal bracing will not be accepted on ductwork below 48 inches.
I. Circumferential and longitudinal seams of all fittings shall be continuous welded. Both sides of all welds shall be painted with zinc chromate primer.
J. Trapeze reinforcement to limit duct deflection to less than 3/4 inch shall be supplied by the spiral pipe manufacturer.
K. Use turning vanes as specified in Section 23 33 00.
L. Access doors at all medium/high pressure fire damper locations shall be of the pressure relief type and approved by NFPA.
M. All flanges, access doors and taps into spiral pipe shall be factory installed. Shipment of loose flanges, access doors, or taps for installation into the spiral pipe in the field will not be allowed.
N. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.04 DUCTMATE SYSTEM
A. Based on a product by Ductmate Industries.
   1. Nexus or Ward equals are acceptable.

B. Ductmate system conforming to SMACNA Class J traverse joint and SMACNA Class F joint, may be substituted under Articles 2.02 and 2.03 above. Installation shall be as recommended by manufacturer and as per SMACNA Installation Standards. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

C. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) shall be accepted. Formed on flanges will be constructed as SMACNA T-25 flanges, whose limits are defined in the SMACNA Manual. No other construction pertaining to formed on flanges, will be accepted. Formed on flanges shall be accepted for use on ductwork 42” wide or less and 2” static positive or less and must include the use of corners, bolts and cleat. (Over 42”, the reinforcement/joint deflection criteria no longer conform to the UMC).

2.05 LOW VELOCITY FLEXIBLE DUCT (INSULATED) (LOW TO HIGH PRESS.)
A. Based on a product by Thermaflex.
   1. Flexmaster, Genflex, and JPL equals are acceptable.

B. Thermaflex Type M-KE: Flexible duct shall have spring steel helix with vinyl coated glass fiber inner liner, wrapped over 1-1/2” thick (R=4.2 @ 75 degree F. per inch thick.) fiberglass insulation and covered with a low permeability outer vapor barrier of fiberglass reinforced film laminated shall complete the composite.

C. Maximum velocity 5,000 FPM, maximum temperature 250°F; operating pressure 10.0” W.G. positive, through 12” I.D., and 6.0” W.G. positive, 14” and 16” I.D. Operating pressure 1.0” W.G. negative through 12” I.D. and 0.5” W.G. negative 14” and 16” I.D. Maximum length shall not exceed 4 feet.

D. Product must meet U.L.-181, Class 1 connector and shall comply with NFPA 90A and 90B.

2.06 HIGH TEMPERATURE FLEXIBLE DUCT
A. Based on a product by Flexmaster
   1. Equals from other manufacturers are acceptable.
B. Flexmaster NI-TL. Duct to be all aluminum construction made from soft aluminum sheet, spiral wound into a tube and spiral corrugated. The construction to be a triple mechanical lock to form a continuous and secure airtight joint. Non-Insulated.

C. Duct to be suitable for 600°F and 5,500 FPM.

D. 10.0" W.G. positive, through 16" I.D., and 6.0" W.G. positive 18" I.D. Operating pressure 12.0" W.G. negative through 16" I.D. and 4.0" W.G. negative 18" I.D.

E. Product must meet U.L.-181, Class 1 connector and shall comply with NFPA 90A and 90B.

2.07 EXHAUST DUCT (MOISTURE LADEN AIR)
A. Exhaust ducts conveying moisture laden air, other than dishwasher exhaust, to be constructed of sheet aluminum in accordance with SMACNA standards.

B. Seal or weld all joints and seams watertight.

2.08 DUCT SEALANT
A. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal.

B. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

C. ALL DUCTS shall be mechanically fastened and sealed with UL Listed Sealants under IECC 503.2.7. Duct tape will not be allowed unless it is UL Listed.

2.09 GASKETS
A. 2 inch Pressure Class and lower: Soft neoprene gaskets in combination with duct sealant for flanged joints.

B. 3 inch Pressure Class and higher: Butyl gaskets.

C. Fume Hood Exhaust: Butyl gaskets

2.10 SPECIAL EXHAUST DUCTWORK
A. Special exhaust ductwork in connection with welding fumes, grinding machines and the sawdust removal system shall be constructed of galvanized sheet steel, 20 gauge for ducts up to 8 inch diameter and 18 gauge for ducts 9 to 24 inches diameter; or equivalent spiral duct.

B. Duct interiors shall be smooth and free of obstructions with girth joints sealed airtight and lapped one inch in direction of flow. Girth joints shall be welded, riveted or screwed however rivets or screws shall not protrude more than 1/4" into the duct. Longitudinal joints shall be lapped and riveted or spot welded on 3 inch centers. Ducts shall be supported at least 12 feet on center.

C. All galvanized iron duct elbows, angles and transitions shall be two gauges heavier than straight lengths of equal diameter, with throat radius of two pipe diameters.

D. High Velocity Flexible Hose: Tubing shall be of a scuff resistant type constructed of a fire retardant fabric with interior and exterior surfaces impregnated with neoprene elastomer. The tubing shall be two ply triple overlap construction. It shall be complete with a bonded exterior scuff strip to provide abrasion resistance. The tubing shall have an interior coated steel wire reinforcing spiral encased within the neoprene and fabric laminations. Tubing shall be able to withstand pressures to 15 inches W.G. positive and negative.

E. Blast Gate: United McGill model GS or equal. Fabricated blast gate with 18 gauge frame and 16 gauge sliding blade and locking device.
F. Blast Gate / Cut-Off: United McGill model COF or equal. Full frame cast aluminum body with 16 gauge sliding blade with locking device.

G. Floor Sweep: United McGill model FS or equal. Fabricated with 18 gauge galvanized steel and shall be complete with hinged closure cover over opening.

H. Access Door: United McGill model ASHXFSDC. Provide size as required to fit duct size at location indicated on plan. Access door shall be of hinged construction with door clasp.

2.11 EXPOSED DUCTWORK (NOT IN MECHANICAL ROOMS)

A. All exposed supply, return, relief, and exhaust duct shall be constructed per the applicable pressure class but made of the galvannealed “paint grip” material. Clean duct with clean rags, washing with a detergent or degreaser, Glidden DEVPREP 88 Heavy Duty Cleaner or equal.

B. On round ducts, provide stamped elbows (preferred). On rectangular ducts, provide radius elbows.

C. Take special care in applying duct sealants. Apply sealants at joints only in a neat and workman-like manner.

2.12 PRE-INSULATED OUTDOOR DUCT


B. Pre-Insulated Duct System.

1. Core: Kingspan KoolDuct. Fiber free closed cell thermoset phenolic foam panels, with thermal conductivity of 0.146 BTU/In/Ft²/hr/degree F at 50-74 deg F. Nominal Density 3.43 – 3.75 pcf. Minimum compressive strength of 29 psi.
   a) Maximum air velocity 5000 fpm.
   b) Maximum Design Pressure 4 In-w.g. Pos. and 3 In-w.g. Neg.
   c) Temperature range -15 deg. F to +185 deg. F.


3. Exterior: High impact strength zero permeability UV stable 1000 micron vinyl shell factory bonded to the insulation. Shell has a tensile strength of 6,350 psi.

4. Color: To be selected by A/E.

5. Duct connection system:
   a) Welded or cohesively bonded seams.
   b) Air distribution segments are connected together with either 4-bolt flange, aluminum channels OR cohesively bonded vinyl couplings.

6. Exceeds SMACNA Air-Leakage Class 1 duct with the Thermaduct connection system.

7. Meets or exceeds IECC 2013 energy code and ASHRAE 90.1 2010 Energy Standards.

8. 10 year leakage warranty.

PART 3: EXECUTION

3.01 GENERAL INSTALLATION

A. Duct sizes indicated on Drawings are inside free area required. Ducts requiring interior insulation liners shall have duct sizes increased the liner thickness.

B. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.
C. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.

D. Test openings for test and balance work will be provided under Section 23 05 93.

E. Include all supplemental angles, channels, etc. of adequate size and design where supports shall be required between building structural members for hanging ductwork. Ductwork shall be supported from the top chord of joists.

F. Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.

G. Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheet metal screws or pop rivets. Trapeze hangers may be used at contractor's option.

H. Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.

I. Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not contact each other by using proper seal or compound.

J. Install all motor operated dampers and connect to all equipment furnished by others. Blank off all unused portions of louvers, as indicated on the drawings, with 2 inch board insulation with galvanized sheet metal backing on both sides.

K. Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.

L. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

M. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

N. Use double nuts and lock washers on threaded rod supports for all ducts.

O. All ducts serving shower exhaust systems shall have soldered joints, pitched to drain. Ductwork may be galvanized steel or aluminum, with watertight joints, caulked and taped.

P. Fill all openings in walls, floors and ceilings, between ductwork and structure with non-combustible insulation packing where ducts pass through same.

Q. Ductwork at connection to reheat coils shall be arranged with flange offset, whenever interior liners are used. Liner shall be flush on inside and not butt against reheat coil heating fins or electric element.

3.02 DUCTWORK

A. Ducts shall be constructed, supported and installed, with duct connections and joints, (slips, seals, locks and angles) in accordance with the latest recommendations of the American Society of Heating, Refrigeration and Air Conditioning Engineer's Guide (ASHRAE), Chapters "Duct Design" and "Duct Construction"; or SMACNA Low and High Pressure Duct Construction Standards, latest edition.

B. Factory fabricated medium pressure ductwork and accessories shall conform to United or Semco recommendations, where in excess of above requirements.

C. Static Pressure Classes
   1. Unless otherwise indicated, construct ducts according to the following:
      a) Supply Ducts (downstream of air terminal units): 2-inch wg.
      b) Supply Ducts (upstream of air terminal units): 4-inch wg.
c) Return/Exhaust Ducts (Negative Pressure): 2-inch wg.
d) Mixed Air Ducts (Negative Pressure): 4-inch wg.
e) Outdoor Air Ducts (Negative Pressure): 4-inch wg.

D. Low Pressure Ductwork:
1. Seal all duct in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.
2. Rectangular ducts with sheet sizes 14 inches and larger shall be cross-broken except where inside liners are applied.
3. Where changes are made in shape of duct, full free areas shall be maintained, tapering joints reduced gradually.
4. Fittings shall be constructed of the same gauges indicated for duct sizes. Long sweep elbows shall be used with radius of throat at least 1.5x width of the elbow. Where this construction cannot be provided, use square elbows with commercial turning vanes.
5. All round ducts shall be constructed with flat locked longitudinal seams and lateral joints lapped in the direction of the airflow. Each lateral joint shall be fastened every five inches in circumferential girth but in no case less than four times in the girth. Each lapped joint shall be securely sealed against leakage by a UL 723 Classified duct sealant.
6. Large ductwork near floor in equipment rooms may be supported with horizontal angles resting on steel floor standards.
7. Install low pressure flexible duct, where indicated on Drawings. The flexible ductwork installation shall comply with the manufacturer’s recommendations. The inner duct surface shall first be wrapped with duct tape and then the banding applied over the duct tape to prevent possible cutting of the inner duct surface during the banding process or by the band. Sheetmetal screws shall not be permitted. Exterior insulation shall then be wrapped with duct tape or banded.
8. Connect grilles, registers, and diffusers to branch ductwork with low pressure duct and low pressure flexible duct.
   a) Maximum installed flexible length - 4 feet.
   b) Do not crimp or crush duct.
   c) Hang duct to provide uniform airflow, using plastic straps, 4 feet on center.

E. Medium/High Pressure Ductwork:
1. Seal all duct in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.
2. System shall have taper transitions in main duct and branches, 5 inches long for each one inch change in diameter. Branches shall enter main duct with 90 degree conical tees, or with 30 or 45 degree angle fittings, connecting at bottom or side.
3. Branch take-offs shall be located at least 4-6 main duct diameters apart or directly opposite each other, never closer than above requirement.
4. No interior duct liner shall be installed on medium/high pressure ductwork; insulation to be installed on exterior of ducts.
5. Acoustic duct turns shall be installed in duct elbows of medium/high pressure system, between AH unit outlet and duct riser.
6. Double wall ducts, shall be installed for all medium/high pressure duct systems, where indicated on Drawings.
   a) Generally this includes duct risers through first two floors (minimum 25 feet) and the first horizontal branch to a floor for a minimum of 15 feet out from riser.
7. High velocity flexible duct shall be provided for medium/high pressure systems, upstream of all VAV boxes; maximum length 5 feet. The flexible ductwork installation shall comply with the manufacturer’s recommendations. The inner duct surface shall first be wrapped with duct tape and then the banding applied over the duct tape to prevent possible cutting of the inner duct surface during the banding process or by the band.

8. Low pressure flexible duct previously specified shall only be used downstream of VAV boxes. Exterior insulation shall then be wrapped with duct tape or banded.

3.03 DUCTWORK SUPPORT
A. Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.

B. Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching serrated spring loaded wedge mechanism fasteners rated for actual load. Steel cable hanging systems will be allowed on round ductwork under 12 inches diameter if installed utilizing two fasteners with two cable loops. Comply with the manufacturer’s installation instructions.

C. Hanger Spacing: Comply with SMACNA’s 2005 “HVAC Duct Construction Standards - Metal and Flexible,” Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

3.04 DUCT CONNECTIONS
A. Ductwork connecting to all fans and blowers shall have at least two (2) fan diameters of straight duct at fan outlets and inlets, before any turns, transitions or duct size changes are made. Duct connection shall be same size as fan outlet or inlet.

B. See Flexible Connections in Section 23 33 00 Duct Accessories.

C. Where more than one outlet is involved, above comments apply and at point 2 fan diameters downstream, the ducts shall be jointed to form "pants". Common discharge shall continue from point of juncture for at least two additional fan diameters before changing size or direction.

D. If greater distances are indicated on drawings, they shall govern.

E. If this method of construction cannot be completed, the A/E shall be contacted before proceeding.

3.05 OUTLETS
A. Make connections to and provide for all grilles, diffusers and other outlets. Install a manual balancing damper in each branch duct for each diffuser or grille. Balancing damper shall be installed just after high-efficiency takeoff and shall include extended operator handle when installed on insulated ductwork. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

3.06 PRE-INSULATED OUTDOOR DUCT SYSTEMS
A. See Specification Section 23 07 13 for insulation thickness and “R” values for outdoor ductwork.

B. Install ducting system in strict accordance with manufacturer’s installation instructions.

C. Seal jacket weather tight.
3.07 CLEANING

A. Interior surfaces shall be free of dust and debris prior to initial startup. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. Any cleaning of duct systems shall comply with recommendations of NAIMA and NADCA.

B. Protect ductwork against entry of foreign matter during construction.

C. When internally cleaning duct work prior to installation or shipment to the jobsite, all duct ends and openings must be covered prior to transporting with a dual Polyethylene protective film. Film must be securely affixed to protect against dirt and debris and must be translucent to facilitate inspection of interior surfaces without removing film. Film must have a minimum elongation of 600%, contain no VOC and leave no residue on duct after removal. Manufacturer: Ductmate Industries ProGuard or approved equal.

D. Clean external surfaces of foreign substances that might cause corrosion, deterioration of the metal, or where ductwork is to be painted.

E. Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers and grilles before operating fans.

F. Provide temporary capping of ductwork to prevent entry of foreign matter during construction.

G. Clean duct systems with high power vacuum machines. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

3.08 BALANCING/AIR

A. The Sheet Metal Subcontractor shall be responsible to make changes in dampers where necessary to obtain the required air volume as determined by the Balancing Contractor. Refer to Balancing Systems, Section 23 05 93.

B. All ductwork and coils shall be cleaned and left free of loose insulation and construction debris.

C. All filters new and existing shall be cleaned or replaced just prior to final balancing.

D. All fans shall be initially started, lubricated and balanced to eliminate noise and vibration.

E. The Contractor shall supply and install all balancing and adjusting dampers shown and as required to obtain final system balance.

3.09 DUCTWORK TESTING

A. The following duct systems shall be tested before any outlets are connected or any exterior insulation is installed:
   1. All ductwork upstream of VAV boxes
   2. All ductwork installed outdoors

B. Representative sections totaling no less than 25% percent of the total installed duct area for that designated ductwork above shall be tested. Should the tested 25% fail to meet the requirements of this section, then 50% of the total installed duct area shall be tested. Should the tested 50% fail to meet the requirements of this section, then 100% of the total installed duct area shall be tested. All sections shall be selected and witnessed by the engineer. Positive pressure leakage testing is acceptable for negative pressure ductwork.

C. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.

D. Sheet metal Contractor shall seal all open ends or ducts and at connection to air handling unit in preparation for testing specified under Section 23 05 93.
E. Conform to SMACNA and ASHRAE test procedures. Test all ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.

F. If excessive air leakage is found, locate leaks, repair the duct in the area of the leak, seal the duct, and retest.

G. LOW PRESSURE DUCTWORK: Leakage testing is not required for low pressure ductwork.

H. MEDIUM/HIGH PRESSURE DUCTWORK: Leakage rate shall not exceed more that table below of the system air quantity for medium/high pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

<table>
<thead>
<tr>
<th>Location</th>
<th>Test Pressure in. wg</th>
<th>Rectangular Ductwork</th>
<th>Round Ductwork</th>
<th>Flat Oval Ductwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Pressure Ductwork</td>
<td>2</td>
<td>9.4</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>All Other Ductwork</td>
<td>4</td>
<td>14.8</td>
<td>7.4</td>
<td>7.4</td>
</tr>
</tbody>
</table>

I. Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the contractor from duct sealing requirements.

J. Submit a signed report as part of the Air Balancing Report, Section 23 05 93, indicating test apparatus used, results of the leakage test, and any remedial work required to bring duct systems into compliance with specified leakage rates.

END OF SECTION 23 31 00
**DUCT LEAKAGE TEST REPORT**

**HSR Project Number:**

**Date Submitted:**

**Project Name:**

**Location:**

**Contractor:**

**Fan No:**

**Leakage Class (C):**

**Data**

**Fan Design CFM:**

**Duct Pressure Class (P):**

**Test Pressure (Pt):**

**Test Equipment**

**Manufacturer:**

**Model No:**

**Serial No:**

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For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

<table>
<thead>
<tr>
<th>Design Data</th>
<th>Field Test Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duct</strong></td>
<td><strong>Duct</strong></td>
</tr>
<tr>
<td><strong>Surface</strong> (Ft²)</td>
<td><strong>Leakage Factor (P.65Cₙ)</strong></td>
</tr>
</tbody>
</table>

**TOTAL**
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SECTION 23 33 00  
AIR DUCT ACCESSORIES  

PART 1: GENERAL

1.01 RELATED DOCUMENTS
A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS
A. Submit in accord with Section 01 30 00.
   1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.

PART 2: PRODUCTS

2.01 TURNING VANES
A. Based on products by Aero Dyne.
   1. Agitair, Carnes, Reliable Metal, Titus, or Tuttle and Bailey equals are acceptable.
B. "Air Turns", factory fabricated, designed to give low pressure loss in square corner ducts.
C. Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

2.02 LARGE TURNING VANES
A. Based on product by Aero Dyne.
B. Whenever both duct dimensions exceed 24 inches, turning vanes shall be Aero/Dyne High Efficiency Profile "H-E-P" type, installed on 2.4 inch centers diagonally across square elbows of supply air duct. Tabbed or slotted dimple fasteners are not acceptable.

2.03 HIGH EFFICIENCY TAKEOFFS
A. Based on product by Sheet Metal Connectors Super HETO with E-Z Flange or equal.
B. All rectangular to round branch duct takeoffs shall be die stamped designed with a rectangular opening and an approximate 45° slope on the body. A flange is turned out on all four sides with each corner being filled. The flange shall be gasketed at main duct to assure a tight seal meeting SMACNA Leakage Class 3.
C. Takeoffs shall be fabricated from both 26 and 24 gauge galvanized steel and be pressure rated for minimum -1" w.g. to +2" w.g.. The fittings shall come with or without volume dampers and damper stand-off equal to insulation thickness for all insulated ductwork systems.
D. For high efficiency takeoffs installed in medium/high pressure ductwork (over 3" w.c.), fittings shall be pressure rated to the system they are installed in.

2.04 DAMPERS
A. Based on product by Air Balance, Cesco-Advanced, Nailor, Ruskin, Semco, United Sheet Metal or Young Regulator Company.
B. Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.

C. Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

D. Dampers used for balancing shall be opposed blade type.

2.05 FLEXIBLE CONNECTIONS

A. Duct connections to equipment shall be made with metal-edged coated fabric with a minimum of 3" of fabric, fire retardant, UL 214 listed, and meet the requirements of NFPA 90A. Fabric shall be air-tight and water-tight. Metal edges to match the duct material, 3" wide, 24 gauge metal mounting strips firmly attached to each edge and suitable for the pressure glass of the air handling system.

B. Based on products by Ventfabrics, Inc.
   1. Flexible connections exposed to the weather other than corrosive environments, fume exhaust or kitchen exhaust shall be heavy glass fabric double coated with Hypalon®, nominal weight 28oz./sq.yd. (Ventlon)

2.06 ACCESS DOORS AND PANELS

A. Doors shall be factory fabricated as manufactured by Advance Air, Inc., Air Balancing, Inc., Acudor Products, Inc., Cesco, Ductmate, Nailor or Ventlok.

B. All access doors and panels required on ductwork shall be provided with airtight hinged access doors with cam sash lock, designed and constructed for the pressure class of the duct in which the door is to be installed.

C. Hinges shall be aluminum or steel full length continuous piano type. Doors in concealed spaces shall be secured in place with cam sash latches. For both hinged and non-hinged doors provide sufficient number of cam sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1” deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1” deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

D. Systems 3” w.g. or less shall utilize a hinged, cam, or hinged & cam square-framed access door.

E. Systems 4” w.g. and above shall utilize a sandwich-type access door. Construct doors in accordance with Figure 7-3 of the 2005 SMACNA Manual, “HVAC Duct Construction Standards, Metal & Flexible” Third Edition. Approved Manufacturer: Ductmate Industries “Sandwich” style door or approved equal

F. Doors shall have safety viewing window when used for access to fire/smoke or smoke dampers.
2.07 GRAVITY BACKDRAFT DAMPERS
A. Based on product by Ruskin.
   1. Louvers and Dampers, Air Balance, Semco or United equals are acceptable.
B. Ruskin heavy duty counterbalanced backdraft damper, Type CBD-6.
C. Frame shall be .125" (3.2) wall thickness 6063T5 extruded aluminum with 12 gage (2.8) galvanized steel structural brace at each corner. Blades shall be .070" (1.8) wall thickness 6063T5 extruded aluminum with extruded vinyl blade edge seals mechanically locked into blade edge. Adhesive or clip on type seals are unacceptable. Bearings shall be corrosion resistant, long life synthetic type for quiet operation. Linkage shall be 1/2" (13) wide tiebar connected to stainless steel pivot pins.
D. Dampers shall be designed for maximum 3500 fpm spot velocities and minimum 4 inches w.g. back pressure depending on damper size.
E. Dampers shall not exceed 0.05" static pressure drop @ 1000 FPM through face area of the damper.
F. Include counterbalanced assembly with pressure range of between 0 to 2" pressure; set to open on pressure of .05 inches, adjustable.
G. Include frame, blades, axles, bearings, etc. as required to complete assembly.

2.08 FIRE DAMPERS (1 ½ HOUR RATED)
A. Based on product by Ruskin.
   1. ACP, Advanced Air, American Warming, Cesco, Dowco, Greenheck, Louvers and Dampers, Nailor, National Controlled Air, Phillips, Pottorff, Prefco and Venco equals are acceptable.
   2. Air Balance "Heat/Seal" with UL label and equal in rating are acceptable.
B. Ruskin Model IBD2 "curtain type" damper U.L. 555 rated for 1-1/2 hour. Use Type B, C or CR for high free area (90 - 100%). For use in static systems.
   1. Type A are approved for use only in certain instances and only with prior approval by Engineer.
   2. Model IBDT (Thinline) fire dampers are also acceptable with prior approval.
C. Construction, 20 gauge galvanized steel frame and collar, 24 gauge (min.) galvanized steel blades with 165°F standard fusible link. Dampers shall be supplied for horizontal or vertical installation in duct, as required. Provide spring type closers.
D. Provide breakaway mounting sleeve of sufficient thickness to permit rigid duct connections. The sleeve shall be a minimum of 16 gauge for dampers up to 36" wide by 24" high and 14 gauge for dampers exceeding 36" wide by 24" high. Damper sleeve shall not extend more than 6" beyond the firewall or partition unless damper is equipped with an actuator or factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the actuator or factory installed access door.
E. Provide angle retainers both sides to conform to UL installation requirements.
F. Each damper or damper assembly shall bear a U.L. label.
G. Dampers shall conform to State Code Requirements for operation specified.
H. The maximum static pressure drop through the damper assembly shall not exceed 0.1” at design airflow.
I. Dampers mounted at grilles in walls and floors. Provide grille mounting angles for flush installation of a minimum 26 gage steel frame grille. No additional mounting angles required on grille side of wall or floor. Damper is offset in the sleeve. Access for inspection and maintenance is through the grille. Based on Ruskin Model "G".

2.09 FIRE DAMPERS (3 HOUR RATED)
A. Based on product by Ruskin.
   1. ACP, Advanced Air, Air Balance, American Warming, Cesco, Dowco, Greenheck, Louvers and Dampers, Nailor, Phillips, Pottorff, Prefco and Venco equals are acceptable.
B. Ruskin Model IBD23, "curtain type" damper, UL 555 rated - Class A, 3 hour. Use Type B, C or CR for high free area (90 - 100%).
   1. Type A are approved for use only in certain instances and only with prior approval by Engineer.
C. Construction, 18 gauge galvanized steel frame and collar, 24 gauge (min.) galvanized steel blades with 165°F standard fusible link. Dampers shall be supplied for horizontal or vertical installation in duct, as required. Provide spring type closers.
D. Provide breakaway mounting sleeve of sufficient thickness to permit rigid duct connections. The sleeve shall be a minimum of 16 gauge for dampers up to 36" wide by 24" high and 14 gauge for dampers exceeding 36" wide by 24" high. Damper sleeve shall not extend more than 6" beyond the firewall or partition unless damper is equipped with an actuator or factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the actuator or factory installed access door.
E. Provide angle retainers both sides to conform to UL installation requirements.
F. Each damper or damper assembly shall bear a U.L. label.
G. Dampers shall conform to State Code requirements for operation specified.
H. The maximum static pressure drop through the damper assembly shall not exceed 0.1" at design airflow.

2.10 DUCT SMOKE DETECTORS
A. Duct smoke detectors provided under Division 26, Electrical.

2.11 THERMOMETERS
A. All gauges and thermometers shall be installed so that they are easy to read, not more than 8 feet above floor. Adjust thermometer head for best viewing. Select scale range to operate at the center of the service range.
B. Thermometers shall be 3" dial type with adjustable angle, stainless steel case and accurate to 1% of scale range unless otherwise noted, based on Tel-Tru #AA-375R.
   1. Acceptable manufacturers are Ametek/US Gauge, Tel-Tru, Trerice and Weksler.

2.12 FLEXIBLE DUCT ELBOWS
A. Based on FlexFlow Elbow by Thermaflex.
   1. Flexmaster FlexRight is acceptable.
B. Universal-mount, one piece, fully adjustable, radius forming brace to support 6-inch through 16-inch diameter flexible air ducts into efficient 90 degree elbow.
C. UL 2043 listed for use in Return Air Plenum Spaces.
D. Molded from composite material.
PART 3: EXECUTION

3.01 AIR TURNS
A. Install turning vanes in all rectangular, mitered elbows in accordance with SMACNA standards and/or manufacturer's recommendations.
B. Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.
C. If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheetmetal turning vanes in accordance with SMACNA Figure 2-5 and Figure 2-6.

3.02 DAMPERS
A. Dampers shall be accessible.
B. Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).
C. Dampers located in ductwork and furnished under Controls Section 23 09 14, shall be installed under this Section.

3.03 FLEXIBLE CONNECTION
A. Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is internally isolated), fans, or other motorized equipment in accordance with SMACNA Figure 2-19. Install thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.
B. For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon coated fabric when making the connector.

3.04 ACCESS DOORS
A. Furnish and install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to
   1. Heating and Cooling Coils
   2. Motorized Dampers
   3. Fire, Fire/Smoke, Smoke Dampers
   4. Airflow Stations
   5. Duct Smoke Detectors
   6. Fan Bearings
   7. Filters
   8. Valves
   9. Control Devices needing periodic maintenance
B. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted coils.
C. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, “SMOKE DAMPER” or “FIRE DAMPER”. Smoke and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

3.05 FIRE DAMPERS/FIRE-SMOKE DAMPERS

A. Install in wall or floor as recommended by manufacturer, conforming to U.L. and State requirements.
B. Seal all openings between wall or floor and damper frame.
C. Include all transitions as required.
D. All fire damper fusible linkage shall be accessible, to permit resetting.
E. Provide the required access panels to service all fire and smoke dampers, with glass viewing ports at smoke dampers.
F. Dampers shall be completely wired, ready for final connection to detector system. Refer to Controls, Section 23 09 14 and DIVISION 26, Electrical.
G. Hand test the fire damper/fire-smoke damper installation after the installation of the ductwork to assure that the damper operates without binding.
H. Permanently identify the access location on the exterior by a label having letters a minimum of 0.5 inch height reading "SMOKE DAMPER" OR "FIRE DAMPER." See Access doors.

3.06 DUCT SMOKE DETECTORS

A. Sheet metal trade shall install duct smoke detectors provided under Division 26, Electrical. Refer to Electrical Drawings for all locations.
B. Install an access door at each detector location.

3.07 THERMOMETERS

A. Provide the following temperature ranges for thermometers:
   1. Air Ducts – Outside Air: Minus 40 to plus 110 deg F, with 2-degree scale divisions.
   2. Air Ducts – Supply and Return Air: 30 to 240 deg F, with 2-degree scale divisions

END OF SECTION 23 33 00
PART 1: GENERAL

1.01 RELATED DOCUMENTS
A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS
A. Submit in accord with Section 01 30 00.
   1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.

PART 2: PRODUCTS

2.01 VARIABLE AIR VOLUME UNITS (HOT WATER REHEAT UNITS)
A. Based on product by Trane Company.
   1. Anemostat, Carnes, Carrier, Enviro-Tec, Krueger, Metalaire, Nailor, Price, Tempmaster, Titus or Tuttle & Bailey equals are acceptable.
B. Units to be of model, type, size and capacities listed in schedules on Drawings.
C. Casing shall be steel. Discharge openings (single or multiple), are provided with flanges for duct connections. Multiple outlet units to have integral outlet connections with factory provided and installed butterfly dampers. Include access panel to service the air valve and the hot water coil.
D. Interior surfaces to be acoustically and thermally lined. Insulation is UL 181 listed and meets NFPA 90A requirements. There shall be no exposed edges of insulation (complete metal encapsulation). Use composite insulation systems (insulation, jackets, sealants, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less.
   1. 1", 1.55# density glass fiber, R-value 3.8, double metal wall around insulation. All wire penetrations are covered by grommets.
E. Air valve shall be a foam seal, steel encased damper blade with either round or rectangular inlet. Integral multiple point, averaging flow sensing ring provides flow measurement within ±5% of rated unit airflow. Integral flow taps and calibration chart provided on each unit. Maximum leak rate is 1% at 4" inlet static pressure for round inlets and 44 cfm at 3" wg. inlet static pressure for rectangular duct connections.
F. Hot water reheat coil: One row, two row, three row or four row coil with aluminum plate fins. Primary surfaces shall be seamless copper tubing and secondary surface of aluminum fin. Include 16 gauge casing of zinc coated steel with channel support.
G. Pressure independent controls provide the airflow required by the room thermostat to maintain setpoint. The air valve automatically adjusts position to compensate for changes in duct system pressure. Factory set, field adjustable minimum and maximum cfm setpoint capability is standard.
H. Room sound level shall not exceed 30 NC with damper closed at a maximum of 1.5 inches inlet static pressure. Provide sound attenuator as required to achieve design noise levels.
I. Furnish all necessary accessory items to complete installation.
J. Controls shall be DDC/VAV with the controller furnished under Section 23 09 93, Temperature Controls, and either factory installed or field installed under cost responsibility of Section 23 09 93. Actuator and hot water control valve (reheat units) shall be furnished under Section 23 09 93 for either factory or field installation with the controller on the box under the cost responsibility of Section 23 09 93. Temperature sensor to be furnished under Section 23 09 93.  

K. The unit controller continuously monitors the zone temperature against its setpoint and varies the primary airflow as required to meet zone setpoints. Airflow is limited by minimum and maximum position setpoints. Upon a further call for heat after the air valve is at the heating minimum, any hot water or electric heat associated with the unit is enabled.

PART 3: EXECUTION

3.01 VARIABLE AIR VOLUME UNITS

A. Install as recommended by manufacturer.

B. Provide all supports as required to suspend units independent of ceiling with adequate access for serving. Provide duct access panels in VAV box and downstream of VAV boxes to service duct coils.

C. Install in duct system as indicated on Drawings; Mount air terminal boxes with a minimum 3 feet of straight ductwork upstream of inlet flow sensor for sizes 12” diameter and below. Provide a minimum of 3X the inlet diameter of straight duct upstream of the inlet flow sensor for inlet sizes above 12” diameter.

D. Provide at least 24” of clearance on controller side of the air terminal unit. The clearance area shall extend the full length of the supply air terminal unit and the full length (including the access door) of the exhaust/return air terminal unit.

END OF SECTION 23 36 00
SECTION 23 37 13
GRILLES, REGISTERS AND DIFFUSERS

PART 1: GENERAL

1.01 RELATED DOCUMENTS
A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS
A. Submit in accord with Section 01 30 00.
   1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.
   2. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

PART 2: PRODUCTS

2.01 GENERAL
A. Grilles or registers shall be of aluminum or steel construction, of size, type, model and capacities listed in schedule on Drawings.
B. All grilles, registers, and diffusers shall come standard white baked enamel finish unless stated otherwise.
C. No screw holes shall be provided on any grille intended for lay-in mounting or concealed fastening. Any grille intended for lay-in mounting shall have border designed to lay on ceiling grid system. Additional cross tees as required shall be furnished by others. Grilles too small to lay on ceiling grid shall be concealed fastened to angle support system resting on ceiling suspension system.
D. Coordinate grille/diffuser & access panel locations with architectural reflected ceiling plan. Provide appropriate frame for ceiling being applied to.
E. Provide directional blow tabs for all supply diffusers shown other than 4-way throw.
F. Frames and flanges for supply air units shall have gasket seals.
G. Grille face shall have adjustable horizontal deflection bars in front, unless otherwise indicated; double deflection shall include adjustable vertical bars.
H. Provide separate frames with removable cores, where indicated.
I. Expanded Metal Grilles: Expanded metal grilles shall be constructed of 14 gauge expanded diamond metal with heavy galvanized frame and mitered corners.
J. DIFFUSERS, REGISTERS & GRILLES IN HUMID LOCATIONS: Diffusers, Registers & Grilles in moisture laden air such as Pools, Locker Rooms, Bathrooms and Showers shall be fabricated out of Aluminum.
K. Door transfer grilles will be furnished by Others.

2.02 GRILLES / REGISTERS / DIFFUSERS
A. Based on product by Krueger.
   1. Agitair, Air Guide, Anemostat, Carnes, Metal-Aire, Nailor, Price, Titus or Tuttle and Bailey equals are acceptable.
B. Grille series description, as follows: Provide opposed blade volume dampers where indicated in schedule on plan. Butterfly or radial dampers are acceptable only if specifically noted in schedule on plan.

1. PLQ: Square faceplate with rounded corners dropped 1/4” is held in place by hooks connected to backpan. The one-piece, stamped backpan and faceplate are of steel construction. Faceplate is removable for damper access.

2. RM4PLQ: Steel anti-smudge round ceiling diffuser with aluminum plaque. The center plaque is adjustable for directing the airflow either horizontal or vertical. A safety cable secures the inner plaque.

3. 880: Double deflection sidewall supply grille with adjustable horizontal and vertical bars. Grilles are of steel construction with bars on 3/4 inch centers and gasketed frames.

4. S80/S580: Return grills with fixed blades mounted on 3/4” centers. S80 grilles are of steel construction and S580 grilles are of aluminum construction.

5. EGC-5: Egg-crate style with 1/2 x 1/2 x 1/2 aluminum core (85% free area) and heavy gauge aluminum frame.

PART 3: EXECUTION

3.01 GRILLES
A. Any return air, vent or transfer grilles having connecting ductwork visible from a standing position, shall have horizontal blades set to conceal duct. When this method is not feasible, the portion of duct exposed to view shall be painted black.

3.02 GRILLES, REGISTERS AND DIFFUSERS
A. Install as recommended by manufacturer.
B. All screw mounting shall be with countersunk screws with mounting screws having the same finish as the grille.
C. Seal connections between ductwork drops and diffusers/grilles airtight.
D. Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into diffuser neck and providing directional control of airflow.
E. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.

3.03 CEILING DIFFUSERS
A. Coordinate installation at tees with ceiling contractor. For linear diffuser locations not over T-bar runners, an additional runner shall be furnished by others. Contractor shall coordinate location with other Trades.
B. Use rigid sheet metal elbows at ceiling diffusers when space permits.
   1. One piece flexible ductwork supports may be used instead of hard elbows, UL listed for use in return air plenum spaces. See Section 23 33 31 Ductwork and 23 33 00 Air Duct Accessories.
C. Maximum flexible duct length to diffuser is 36” or 5 duct diameters, whichever is longer.
D. On field constructed diffuser plenums, provide 1 inch vapor barrier insulation.
3.04 AIR PATTERN ADJUSTMENT

A. Adjust ceiling diffusers to airflow patterns shown on plans, in schedules and specifications, provide deflection baffles if required. Adjust slot diffuser blades to obtain the patterns indicated, contact engineer if desired pattern is in question. Typically if the slot is located in the center of the room adjust half the slots to horizontal airflow in one direction and the other half in the other direction, if it is located near a wall adjust all the slots to horizontal airflow away from the wall. Adjust blades of adjustable blade louvered face sidewall supply grilles and registers to patterns indicated in schedule.

3.05 VOLUME DAMPERS

A. Provide volume dampers at all branch ducts connecting to main ducts.

END OF SECTION 23 37 13
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SECTION 23 74 13
PACKAGED GAS/ELECTRIC ROOFTOP UNITS

PART 1: GENERAL

1.01 RELATED DOCUMENTS
A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS
A. Submit in accord with Section 01 30 00.
   1. Shop drawings and descriptive product data describing all material furnished under Part 2 of this Section.
B. Product Data: Submit capacities and accessories included with air handling unit. Include general layout, dimensions, size and location of pipe and duct connections, electrical characteristics, weight, mounting loads and unit acoustics.
   1. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.03 QUALITY ASSURANCE
A. Source Limitations: Obtain unit with all appurtenant components or accessories from a single manufacturer.
B. For the actual fabrication, installations, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
C. Product Options: Drawings must indicate size, profiles, and dimensional requirements of Energy Recovery Unit and are to be based on the specific system indicated. Refer to Division 1 Section “Product Requirements”.
D. Certifications
   1. Blowers shall be AMCA Certified for airflow.
   2. Entire unit shall be ETL Certified per U.L. 1995 and bear an ETL sticker.
   3. C22.2 No 236.05. DX and water coils shall be AHRI Certified per standard 410-2001.

1.04 EXTRA MATERIALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: 2 set(s) of MERV 8 disposable filters for each unit.
   2. Furnish a complete set of fan motor drive belts.

1.05 WARRANTY
A. One year parts only warranty on entire unit beginning upon substantial completion of project.
B. Five year replacement compressor(s) warranty beginning upon substantial completion of project.
C. Five year heat exchanger(s) warranty beginning upon substantial completion of project.
D. One year labor warranty from date of substantial completion to be covered by mechanical contractor.
E. Include factory startup by trained and authorized service technician confirming equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty.

1.06 DELIVERY, STORAGE AND HANDLING
A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.07 EQUIPMENT START-UP
A. Provide system start-up; the equipment manufacturer's representative will provide supervision and be in attendance during unit start-up.
   1. Equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation. Submit four copies of a written startup report following the initial start up to be included to O&M manuals. Include in the report: work done to the system, all readings taken, a statement certifying that the unit(s) have been placed in proper running condition as recommended by the manufacturer and as intended in the drawings and specifications.

PART 2: PRODUCTS

2.01 PACKAGED GAS/ELECTRIC ROOFTOP UNIT
A. Based on a product by Trane.
   1. Aaon, Carrier, Daikin, and York / JCI equals are acceptable.
B. Units shall be of types, sizes, models and capacities listed in schedule on Drawings.
C. GENERAL: Units shall be factory assembled, single package, Gas/ Electric, designed for outdoor installation. They shall have built in field convertible duct connections for down discharge supply/return or horizontal discharge supply/return and be available with factory installed options or field installed accessories. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation and control sequence, before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled, classified in accordance to UL 1995/C 22.2, 236-05 3rd Edition. Packaged Rooftop units cooling, heating capacities, and efficiencies are AHRI certified within scope of AHRI Standard 340/360 (I-P) and ANSI Z21.47 and 10 CFR Part 431 pertaining to Commercial Warm Air Furnaces (gas heating units).
D. CASING: Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit’s surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. In order to ensure a water and air tight seal, service panels shall have lifting handles and no more than three screws to remove. All exposed vertical panels and top covers in the indoor air section shall be insulated with a 1/2-inch, 1-pound density foil-faced, fire-resistant, permanent, odorless, glass fiber material. The base of the downflow unit shall be insulated with 1/2-inch, 1-pound density foil-faced, closed-cell material. The downflow unit’s base pan shall have no penetrations within the perimeter of the curb other than the raised 11/8-inch high supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting.

1. The top cover shall be one piece, or where seams exist, double hemmed and gasket sealed to prevent water leakage.

E. INDOOR FAN: Units above shall have belt driven, FC centrifugal fans with adjustable motor sheaves. Units with standard motors shall have an adjustable idler-arm assembly for quick-adjustment of fan belts and motor sheaves. All motors shall be thermally protected. Oversized motors shall be available for high static application. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).

F. OUTDOOR FANS: The outdoor fan shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor(s) shall be permanently lubricated and shall have built-in thermal overload protection.

G. FILTERS: Provide 2-inch MERV 8 filters.

H. COMPRESSORS: All units shall have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of nameplate voltage. Internal overloads shall be provided with the scroll compressors. All models shall have crankcase heaters, phase monitors and low and high pressure control as standard. Dual compressors are available on all standard efficiency models and 12.5 to 20 tons high efficiency models and allow for efficient cooling utilizing 3 stages of compressor operation (high efficiency models only). 25 tons high efficiency units have 3 compressors for up to 4 stages of compressor operation.

I. EVAPORATOR AND CONDENSER COILS: Microchannel coils will be burst tested by the manufacturer. Internally finned, 5/16” copper tubes mechanically bonded to a configured aluminum plate fin shall be standard on high efficiency models and microchannel shall be standard on standard efficiency for evaporator coils. Microchannel condenser coils shall be standard on all units. Coils shall be leak tested to ensure the pressure integrity. The evaporator coil and condenser coil shall be leak tested to 225 psig and pressure tested to 450 psig. Sloped condensate drain pans are standard.

J. REFRIGERANT CIRCUITS: Each refrigerant circuit shall have independent fixed orifice or thermostatic expansion devices, service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers. Thermal Expansion Valves (TXVs) shall be standard on all high efficiency units.
K. MODULATING GAS HEATING SECTION: The heating section shall have a drum and tube heat exchanger design using stainless steel components. A variable speed forced combustion blower shall supply premixed fuel to a single burner ignited by a pilotless hot surface ignition system. The leaving air temperature shall be communicated to the unit controls (ReliaTel) via a discharge air sensor. This information along with the space temperature will be used to modulate the heating output. In order to provide reliable operation, a pressure switch will require blower operation to initiate gas flow. On an initial call for heat the combustion blower shall purge the heat exchanger 45 seconds before ignition. The heat exchanger will operate at full fire initially and then modulate down to match the desired discharge air temperature. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset. Units shall be suitable for use with natural gas. Heating section shall be provided with the following minimum protection:

1. Primary and auxiliary high-temperature limit switches.
2. Induced draft pressure sensor.
3. Flame roll out switch (manual reset).
4. Flame proving controls.

L. CONTROLS: Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Unit shall provide an external location for mounting a fused disconnect device. ReliaTel controls shall be provided for all 24-volt control functions. The resident control algorithms shall make all heating, cooling, and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized control shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection.

M. DEFROST CONTROLS: Adaptive demand defrost shall be provided to permit defrost wherever coil icing conditions begin to significantly reduce unit capacity.

N. DISCHARGE LINE THERMOSTAT: A bi-metal element discharge line thermostat is installed as a standard option on the discharge line of each system. This standard option provides extra protection to the compressors against high discharge temperatures in case of loss of charge, extremely high ambient and other conditions which could drive the discharge temperature higher. Discharge line thermostat is wired in series with high pressure control. When the discharge temperature rises above the protection limit, the bi-metal disc in the thermostat switches to the off position, opening the 24 Vac circuit. When the temperature on the discharge line cools down, the bi-metal disc closes the contactor circuit, providing power to the compressor. When the thermostat opens the fourth time, the ReliaTel control must be manually reset to resume operation on that stage.

O. VARIABLE FREQUENCY DRIVE: Variable Frequency Drives are factory installed and tested to provide supply fan motor speed modulation, as well as modulating gas heat. VFDs on the supply fan, as compared to inlet guide vanes or discharge dampers, are quieter, more efficient, and are eligible for utility rebates. All VFDs are designed to allow bypass if required.

P. ELECTRICAL: All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry to minimize roof penetrations and avoid unit field modifications. Separate side and bottom openings shall be provided for the control wiring.
Q. STANDARD FEATURES:
1. Crankcase Heaters.
2. Phase Monitor: A three-phase line monitor module that protects against phase loss, phase reversal and phase unbalance. It is intended to protect compressors from reverse rotation. It has an operating input voltage range of 190–600 Vac, and LED indicators for ON and FAULT. There are no field adjustments and the module will automatically reset from a fault condition.

R. FACTORY INSTALLED OPTIONS:
1. Stainless Steel Drain Pan.
2. Fault Detection & Diagnostics (FDD) meets the mandatory requirement of Title 24. This option provides detection of the following faults: Air temperature sensor failure/fault, not economizing when it should, economizing when it should not, damper not modulating, and excessive outdoor air. The FDD system shall be certified by the Energy Commission as meeting the requirements.
3. Hinged Access Doors: Sheet metal hinges are available on the Filter/Evaporator Access Door and the Compressor/Control Access Door.
4. Human Interface: The Human Interface shall have a 5 inch color touchscreen display that conforms to FCC Part 15 Class B with an Ingress Protection Rating of IP24. The display text shall be readable by a person with 20/20 vision at a distance of 3 feet and 60° angle at lighting levels ranging from 100 lux - 25,000 lux. Also, the display shall operate at temperatures of -40° C to 70° C. Firmware and unit configurations shall be able to be restored via a USB storage device.
5. Fan Speed Control:
   a) Multiple-Zone VAV Control. Multiple-zone VAV control shall vary the speed of the indoor fan to maintain the duct static pressure at a setpoint. In cooling mode, the compressors shall be cycled (or economizer modulated) to maintain the supply air temperature (SAT) at the desired setpoint. In heating mode, the indoor fan shall operate at maximum speed whenever the heater operating.
6. VAV Operation. The VFD shall receive a 0-10 Vdc signal from the unit control based upon supply static pressure, and shall cause the drive to accelerate or decelerate as required to maintain the supply static pressure setpoint. When subjected to high ambient return conditions the VFD shall reduce its output frequency to maintain operation.

S. FIELD INSTALLED OPTIONS:
1. Barometric Relief. Designed to be used on downflow units, barometric relief is an unpowered means of relieving excess building pressure.
2. Clogged Filter/Fan Failure Switch. A dedicated differential pressure switch is available to achieve active fan failure indication and/or clogged filter indication. These indications will be registered with either a zone sensor with status indication lights or an Integrated Comfort™ System.
3. Motorized Outside Air Dampers. Manually set outdoor air dampers shall provide up to 50% outside air. Once set, outdoor air dampers shall open to set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.
4. Dry Bulb Economizer - Low Leak. This accessory meets low leak requirements for ASHRAE 90.1, IECC, and CA Title 24 standards (3 cfm/ft²@1” wg exterior air, 4 cfm/ft²@1” wg return air). This option allows 100% outdoor air supply from 0-100% modulating dampers and is standard with barometric relief. It can be paired with powered exhaust for additional building pressure relief. This option can be paired with or without Fault Detection & Diagnostics (FDD) to meet current mandatory CA Title 24 requirements.

5. Indoor Fan Motor Shaft Grounding Ring. Shaft grounding rings are used on all VFD driven motors to provide a conductive discharge path away from the motor bearings to ground. Bearing Protection Ring shall be maintenance free circumferential ring of conductive micro fibers that discharges voltages to ground.

6. Insulated Horizontal Discharge Roof Curb. No Pitch, 2” insulation (R-8), 18 gauge solid insulated floor, wood nailer, divider wall, horizontal supply, horizontal return, slab mounted w/ Vulkem bottom seams.

T. WARRANTIES: Compressor – 5 Years, Heat Exchanger – 5 Years, Parts – 1 Year.

PART 3: EXECUTION

3.01 GENERAL INSTALLATION
A. Install as recommended by manufacturer.
B. Install unit in the vertical configuration on roof.
C. Install roof curb as recommended by manufacturer. Provide insulation and sound proofing per detail on plans.
D. Provide vibration isolation for supply fan.
E. Return air smoke detector furnished and wired under Division 26, Electrical. Smoke detector installed under this Section.
F. Installation of control wiring shall be supervised by unit supplier.
G. Extend piping from condensate drain pans and install trap seal. Drain on roof.
H. At all points where rooftop unit components are joined, provide gasket or caulking bead to reduce leakage.
I. Entire unit casing shall be factory insulated and weatherproof.

3.02 CONNECTIONS
A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
   1. Piping installation requirements are specified in Division 23. Drawings indicate general arrangement of piping, fittings and specialties.
   2. Duct installation and connection requirements are specified in Division 23 of this document.

3.03 UNIT START-UP
A. Manufacturer’s Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer’s IOM.
B. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Measure and record electrical values for voltage and amperage. Refer to Section 23 05 93 and comply with provisions therein. Engage a factory authorized service representative to train owner’s maintenance personnel to adjust, operate and maintain the entire unit.

C. Air handling unit shall not be used for temporary heating and cooling purposes without the consent of the Architect/Engineer.

3.04 DEMONSTRATION AND TRAINING

A. Engage a factory authorized service representative to train owner’s maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

3.05 WIRING

A. Wiring under Division 26, Electrical; including mounting of starters, specified under Division 23.

END OF SECTION 23 74 13
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SECTION 23 81 01
HYDRONIC TERMINAL UNITS

PART 1: GENERAL

1.01 RELATED DOCUMENTS
   A. Conditions of the Contract and portions of Division One of this Project Manual apply to
      this Section as though repeated herein.
   B. The requirements of Section 23 05 00 apply to this Section.

1.02 SUBMITTALS
   A. Submit in accord with Section 01 30 00.
      1. Shop drawings and descriptive product data describing all material furnished under
         Part 2 of this Section.
      2. Submit printed color chart to Architect.

PART 2: PRODUCTS

2.01 GENERAL
   A. Based on 20 degrees F. temperature drop, unless indicated otherwise in schedules.

2.02 CABINET HEATERS
   A. Based on products by Rittling.
      1. Airtherm, Daikin, Modine, Sigma, Sterling, Trane, and Vulcan equals are acceptable.
   B. Cabinet heaters shall be model, size and capacity listed in schedule on Drawings.
   C. Cabinet back and ends shall be 18 gauge steel, top and front shall be 16 gauge.
   D. Hinged access door is flush with the unit.
   E. Finish to be baked powder coat of a standard color selected by Architect.
   F. Include a throwaway filter and rack, replace with new filter prior to building occupancy by
      Owner, if units are used for temporary heating.
   G. Fans shall be centrifugal forward curved DW wheels, direct drive.
   H. Motor shall be electrically commuted motor (ECM) and have built-in overload protection;
      provide electric disconnect.
   I. Heating coil shall be designed for use with hot water, 140 degrees F. (maximum); seamless
      copper tubes with aluminum fins.

2.03 COMMERCIAL FINNED TUBE RADIATION
   A. Based on product by Rittling.
      1. Slant-Fin, Sterling, Vulcan or Weil-McLain equals are acceptable.
   B. Finned tube radiation to be of model, type, size and capacity listed in schedule on Drawings.
   C. ENCLOSURES: Cabinets shall be 16 gauge steel construction, locked to adjacent
      cabinet or accessory and with mounting strips and support brackets, not more than four
      (4) feet on center. Finish to be baked powder coat of color selected by Owner.
   D. HEATING ELEMENTS: Construct heating elements of aluminum fin on copper tube.
      Provide wall mounted support cradles, which allow expansion of heating element without
      noise. Elements shall be designed for use with hot water, 140 degrees F. (maximum).
E. ACCESSORIES: Include trim strips, end caps, dampers, corners, mounting strips and support brackets as required to complete installation. Where wall-to-wall installations are indicated on plans, provide extensions or field modification of enclosure to conform to the actual room dimensions.

F. Provide hinged access doors at all valves, traps and vents. Provide dirt gasket for mounting between back panel and wall.

PART 3: EXECUTION

3.01 GENERAL INSTALLATION

A. Mount all units securely to structure, where shown on Drawings.

B. Openings and lintels for recessed convectors and cabinet heaters, see Architectural/Structural Drawings.

C. All new equipment shall be installed as recommended by manufacturer.

D. Provide 1/2 inch thick rigid insulation board on backs of all recessed convectors and cabinet heaters installed in outside walls.

E. Install all baseboard and/or wall-fin enclosures, components and accessories to form a neat finished appearance. All covers and end strips shall be secure to hangers, and overlaps shall fit tight.

F. Coordinate special wall-fin elements and enclosures.

G. Install compressible filler strip between cabinet and wall to prevent heat streakage and adjust for wall irregularities

3.02 WIRING

A. Wiring of motors under Division 26, Electrical.

END OF SECTION 23 81 01
SECTION 26 00 00

TABLE OF CONTENTS FOR ELECTRICAL SYSTEMS

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END OF SECTION 26 00 00
PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.02 REFERENCE STANDARDS

A. Abbreviations of standards organizations referenced in this and other sections are as follows:
   - ANSI: American National Standards Institute
   - ASTM: American Society for Testing and Materials
   - EPA: Environmental Protection Agency
   - ETL: Electrical Testing Laboratories, Inc.
   - IEEE: Institute of Electrical and Electronics Engineers
   - IES: Illuminating Engineering Society
   - ISA: Instrument Society of America
   - NBS: National Bureau of Standards
   - NEC: National Electric Code
   - NEMA: National Electrical Manufacturers Association
   - NESC: National Electrical Safety Code
   - NFPA: National Fire Protection Association
   - UL: Underwriters Laboratories Inc.
   - DSPS: Wisconsin Department of Safety and Professional Services

1.03 REGULATORY REQUIREMENTS

A. All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State Electrical Code (SPS 316), the National Electrical Code (NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).

B. All Division 26 work shall be done under the direction of a currently certified State of Wisconsin Certified Master Electrician.

1.04 QUALITY ASSURANCE

A. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space, and for obtaining the performance from the system into which these items are placed.

B. Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

C. All materials shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by Western Technical College, shall apply and such items shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system shall be so labeled.
1.05 CONTINUITY OF EXISTING SERVICES AND SYSTEMS

A. No outages shall be permitted on existing systems except at the time and during the interval specified by the user agency and by the Project Representative. The institution may require written approval. Any outage must be scheduled when the interruption causes the least interference with normal institutional schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

B. This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible.

1.06 PROTECTION OF FINISHED SURFACES

A. Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.07 APPROVED ELECTRICAL TESTING LABORATORIES

A. The following laboratories are approved for providing electrical product safety testing and listing services as required in these specifications:
   1. Underwriters Laboratories Inc.
   2. Electrical Testing Laboratories, Inc.

1.08 SEALING AND FIRESTOPPING

A. Sealing and firestopping of sleeves/openings between conduits, wireways, etc. and the structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.09 WESTERN TECHNICAL COLLEGE FURNISHED EQUIPMENT AND WORK

A. Closed Circuit Television (CCTV) Cameras (Only):
   1. WTC shall provide all Closed Circuit Television IP cameras and testing. Electrical Contractor shall install.

B. Power-Over-Ethernet Network Switches:
   1. WTC shall provide and install all Power-over-ethernet switches for equipment racks.

C. Electronic Door Access System:
   1. WTC shall provide and install all Electronic Door Access system devices. Electrical Contractor shall provide and install All Low-Voltage (Smart) wiring and EMT conduit raceway system. Flexible conduit shall be installed inside hollow metal door frames as required. Termination and programming of Low-Voltage cables by WTC. Electrical Contractor shall coordinate wiring and conduit requirements with WTC.

1.10 PROVISIONS FOR FUTURE WORK

A. Exterior of Building:
   1. Please note there is planned to install a future 'Emergency Generator' in the sand lot on the North side of the project adjacent to Electrical Room #120. The Electrical Contractor shall provide empty conduits to the exterior of the building from Automatic Transfer Switches ‘ATLS’ and ‘ATSEQ’ as noted on the drawings.
2. Please note there is planned to install future ‘Solar Panels’ in the Parking Lot on the East side of the Parking Lot. The Electrical Contractor shall provide empty conduits and in-ground junction boxes as noted on the drawings.

1.11 INTENT

A. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.

B. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits Western Technical College’s intent (as determined by the WTC Project Manager). Refer to the General Conditions of the Contract for further clarification.

C. It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.

D. All sizes as given are minimum except as noted.

E. Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the WTC’s and/or A/E’s inspections, tests and approval from the commencement until the acceptance of the completed work.

F. Whenever a particular manufacturer’s product is named, it is intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

1.12 OMISSIONS

A. No later than ten (10) days before bid opening, the Contractor shall call the attention to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

1.13 SUBMITTALS (ELECTRONIC IS ACCEPTABLE)

A. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.

B. On request from the A/E, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.

C. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.

D. The submittals must be approved before fabrication is authorized.

E. Submit sufficient quantities of submittals to allow the following distribution:
   - Operating and Maintenance Manuals: 2 copies
   - User agency: 1 copy
   - A/E: 1 copy
   - WTC Field Office: 1 copy

1.14 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on drawings, unless prevented by project conditions.

B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission before proceeding.
C. Tools, materials and equipment shall be confined to areas designated by the Western Technical College and or the Users Agent.

D. Ceilings are used for environmental air distribution, ALL low voltage wiring shall be **PLENUM** rated.

### 1.15 WORK SEQUENCE AND SCHEDULING

A. Install work in phases to accommodate user agency's occupancy requirements. During the construction period coordinate electrical schedule and operations with WTC's Construction Representative.

### 1.16 WORK BY OTHER TRADES

A. Every attempt has been made to indicate in this trade's specifications and drawings all work required of this Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and additional notes on drawings for other trades which pertain to this trade's work, and thus those additional requirements are hereby made a part of these specifications and drawings.

B. Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

### 1.17 SALVAGE MATERIALS

A. No materials removed from this project shall be reused [except as specifically noted below]. All materials removed shall become the property of and shall be disposed of by the Contractor.

B. The following material shall be removed from service and turned over to Western Technical College at a site selected by the WTC in the same condition as when it was removed:
   1. All existing Notifier fire alarm system devices.
   2. All existing public address speakers.
   3. All existing Electronic Door Access System wiring removed.
   4. All existing Welding Disconnects removed shall be palletized and shrink-wrapped for an Auction Sale.
   5. All ‘Home-run’ conductors #10 AWG and larger (copper) shall be recycled into containers provided by WTC.
   6. All specialized wiring devices not re-used shall be salvaged, palletized and shrink-wrapped for an Auction Sale.

### 1.18 CERTIFICATES AND INSPECTIONS

A. Obtain and pay for all required Local Electrical installation inspections.

B. This contractor is responsible for coordination of electrical inspections.

### 1.19 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section **GENERAL REQUIREMENTS**.

B. In addition to the general content specified under **GENERAL REQUIREMENTS** supply the following additional documentation:
   1. Manufacturer’s wiring diagrams for electrically powered equipment.

### 1.20 RECORD DRAWINGS

A. The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.
B. The A/E will provide the Contractor with a suitable set of contract drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.
C. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.
D. At completion of the project, the Contractor shall submit the marked-up record drawings to the A/E prior to final payment.

PART 2 - PRODUCTS

2.01 ACCESS PANE LS AND DOORS
A. Lay-in Ceilings: Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are sufficient; no additional access provisions are required unless specifically indicated.
B. Concealed Spline Ceilings: Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used will be provided under other divisions.
C. Metal Pan Ceilings: Removable sections of ceiling tile held in position by pressure fit will be provided under other divisions.
D. Plaster Walls and Ceilings: 16-gauge frame with not less than a 20-gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver operated cam latch for general application, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.02 IDENTIFICATION
A. See Electrical section 26 05 53 – Identification for Electrical Systems.
B. Provide an adhesive type label on the cover plate of each duplex and double-duplex receptacle with branch-circuit number.

2.03 SEALING AND FIRESTOPPING
A. Fire and/or Smoke Rated Penetrations:
   1. Manufacturers: 3M, STI/SpecSeal, Tremco, Hilti or approved equal.
   2. All firestopping systems shall be by the same manufacturer.
   3. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
   4. Product: Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Safety and Professional Services.
   5. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
   6. Refer to Architectural Drawings for identification of smoke partitions and fire rated walls. Contractor shall use firestop putty, caulk sealant, intumescent wrap strips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
B. Non-rated penetrations:
1. **Conduit Penetrations:** At conduit penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

**PART 3 - EXECUTION**

**3.01 EXCAVATION AND BACKFILL**

A. Perform all excavation and backfill work to accomplish indicated electrical systems installation.

**3.02 CONCRETE WORK**

A. The Electrical Contractor will provide a concrete base for pole lighting fixtures. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.

B. Coordinate with General Contractor for a 4” high concrete base for Switchboard #1 located in Electrical Room #120. General Contractor shall provide. In addition, coordinate with General Contractor to saw-cut existing concrete floor for Switchboard #1 simulated underground electric service conduits, saw-cutting by General Contractor.

**3.03 CUTTING AND PATCHING**

A. Refer to Division 1, General Requirements, Cutting and Patching.

**3.04 BUILDING ACCESS**

A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

**3.05 EQUIPMENT ACCESS**

A. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.

**3.06 COORDINATION**

A. The Contractor shall cooperate with other trades in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

B. The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.

C. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
3.07 SLEEVES

A. Pipe sleeves for conduits 6" in diameter and smaller, in new poured concrete construction, shall be schedule 80 PVC, all cast in place.

B. In wet area floor penetrations, the top of the sleeve shall be 2 inches above the adjacent floor. In existing wet area floor areas, core drill sleeve openings large enough to insert a schedule 80 sleeve and grout the area around the sleeve. If a pipe clamp resting on the sleeve supports the pipe penetrating the sleeve, weld a collar or struts to the sleeve that will transfer weight to the existing floor structure. Wet areas for this paragraph are rooms or spaces containing air handling unit coils, converters, pumps, chillers, boilers, and similar waterside equipment.

C. Provide adequate quantity and size of conduit sleeves for Low-Voltage wiring between floors and between Server Rooms. Coordinate with Western Technical College Information Technology Department.

3.08 SEALING AND FIRESTOPPING

A. Fire and/or Smoke Penetrations:
   1. Install approved product in accordance with the manufacturer's instructions where a pipe (i.e. conduit, wireway, trough, etc.) penetrates a fire rated surface.
   2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.

B. Non-Rated Surfaces:
   1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
   2. Install escutcheons or floor/ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.
   3. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building.

3.09 HOUSEKEEPING AND CLEAN UP

A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

3.10 TEMPORARY ELECTRICAL WORK

A. Temporary Electric Power shall be fed from an existing panelboards located in Electrical Room #109. The Electrical contractor shall coordinate thoroughly with Western Technical College Facility Management Department to determine best source for Temporary Electric Power. Western Technical College shall pay for monthly electric service.

B. If a Contractor contemplates the use of equipment that requires a different voltage or greater capacity than that specified, then that Contractor must arrange with Western Technical College for this additional service and pay for installation of the service and the necessary additional switches and wiring required.

C. The meter shall remain in Western Technical College's name.

D. Western Technical College shall pay for all electrical energy consumed for construction purposes for all trades including temporary offices, for operation of ventilating equipment, for heating of building, and for testing and operating of all equipment.

E. Any Trade that has a temporary office shall provide and pay for installation of temporary service for lighting of such temporary office.
F. The Electrical Contractor shall provide, at no cost to others, all lamps, wiring, switches, sockets and similar equipment required for temporary system until substantial completion. Upon completion of the project, the Electrical Trade shall remove the existing temporary electric power system.

G. The temporary lighting system shall be sufficient to enable all trades to safely complete their work. Illumination shall be 5 foot-candles minimum in all areas and, in addition, shall meet or exceed the requirements of 29 CFR 1926.56 Illumination (OSHA regulations).

H. Provide at least one duplex outlet for small power tools for each 400 square feet of floor space, 120-volt single phase. Circuits shall be 20 ampere, single pole.

I. In accordance with the latest issue of the National Electrical Code, all temporary electrical circuits for construction purposes shall be equipped with combination ground fault interrupter and circuit breakers meeting the requirements of UL for Class A, Group 1 devices. The ground fault interrupter portion shall be solid state type, insulated and isolated from the breaker mechanism. A test button shall be provided for checking the device. The breaker mechanism shall provide overload and short circuit protection and shall be operated by a toggle switch with over-current switching mechanism so that contact cannot be held closed.

J. All Trades shall furnish their extension cords and lamps other than those furnished for general lighting.

K. All Trades and other separate Contractors shall be allowed to use the service provided for general lighting and fractional horsepower hand tools at no cost.

L. Those trades requiring lighting or other electrical service outside of building shall pay for the installation and removal of service, maintenance charges.

M. Trades requiring voltage other than basic temporary system specified, shall make their own arrangements with the Electrical Contractor for the cost of installation, and removal when no longer required.

N. Heating and Ventilating Trade shall provide wiring, equipment and connections for portable or temporary heating units.

O. The Electrical Contractor shall expedite the work under this contract in such a manner that the permanent power wiring system and panels will be installed and connected to permanent heating and ventilating equipment in time to operate and test this equipment when the building has been closed sufficiently to permit the use of portions of heating and ventilating system for temporary heating during construction. Permanent wiring and connections may be used at permanent equipment; however, the use of the permanent system during construction shall in no way waive any part of the guarantee period.

P. After Substantial Completion of the permanent electrical system and building wiring, permanent receptacles may be used during finishing work. Permanent wiring for lighting fixtures, switches and receptacles shall be installed only after all masonry and plastering has been completed, but this wiring shall not be used for motors larger than fractional HP or for welding equipment. Circuits for larger motors and welding equipment may be provided with special circuits to mains of electrical panels at the expense of those trades requiring them, provided that special permission is obtained from Western Technical College’s Project Representative and the installation is made by skilled electricians.

1.11 WARRENTY

A. Electrical contractor shall provide a 2-year minimum warranty for product and labor.

END OF SECTION 26 05 00
SECTION 26 05 02
ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work as specified in the individual Sections.
B. Provide Stainless Steel blank cover plates for ALL junction boxes requiring them. This include multi-gang junction boxes in addition to standard single, double, triple and four gang boxes. Provide blank metal cover plates for pull boxes, larger junction boxes and enclosures as required, No exceptions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements as shown on Drawings.
B. Verify that abandoned wiring and equipment serve only abandoned facilities.
C. Verify whether or not PCB ballasts exist in light fixtures which will be disposed of. If PCB light fixture ballasts exist, then follow requirements in PCB BALLAST HANDLING AND DISPOSAL and LAMP AND PCB BALLAST DISPOSAL below.
D. Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the User Agency, Architect/Engineer and WTC Field Representative before disturbing existing installation.
E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
B. Coordinate utility service outages with the User Agency, WTC Field Representative, and Architect/Engineer. Coordinate utility service outages with the local Utility Company (Not anticipated to be required for this project).
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. In particular, all security and safety systems must be maintained in operation at all times as required by the User Agency. This includes security and safety lighting.
D. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Obtain permission from the User Agency, WTC Field Representative and local Authority Having Jurisdiction at least 48 hours before partially or completely disabling system. Minimize outage duration. If required, make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work to meet all requirements of these specifications.
B. If certain raceways and boxes are abandoned but not scheduled for removal, those items must be shown on the "As Built Drawings".
C. Remove, relocate, and extend existing installations to accommodate new construction.
D. Remove abandoned wiring to source of supply. Do not abandon wiring in place.
E. Provide revised typed circuit directory in panelboards that have circuits removed.
F. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
G. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover plates for abandoned outlets, junction boxes, pull-boxes, backboxes, etc. which are not removed.
H. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
I. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
J. Repair adjacent construction and finishes damaged during demolition and extension work.
K. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
L. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. This includes the extension of the circuit from the last active device to the next device in the system to be activated.

3.04 PCB BALLAST HANDLING

A. Generally, all high-power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain polychlorinated biphenyl (PCB) compounds in their capacitors. The Contractor shall inspect all ballasts in all light fixtures and take the actions described below.
1. The disposal of all ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the responsibility of the Contractor. If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.
2. All PCB ballasts shall be removed from the light fixtures and shall have the wires clipped off. However, before removal, all PCB ballasts shall be carefully inspected for leaks. If a ballast appears to be leaking (evidenced by potting compound leaking out or by an oily film on the ballast surface) the ballast must be handled per EPA and DNR PCB regulations.
3. THESE PCB BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE BY THE CONTRACTOR. To do so would be a violation of DNR and DOT hazardous waste regulations and may result in a fine to the Contractor.

B. See Lamp and PCB Ballast Disposal instructions below.

3.05 LAMP AND PCB BALLAST DISPOSAL

A. All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy metals and compounds which are regulated by the EPA and DNR during the disposal process. As a result, regulations have been issued covering the handling and disposal of all lamps. Therefore, lamps which have been removed from service for disposal shall be handled as follows by the Contractor:
1. The Contractor shall very carefully remove all lamps (fluorescent, incandescent, and HID) from light fixtures before removal of the fixture from its mounted position. This is to reduce the likelihood that the lamp(s) will be broken.

3.06 INSTALLATION

A. Install relocated materials and equipment as noted on drawings.

END OF SECTION 26 05 02
SECTION 26 05 04
CLEANING, INSPECTION, AND TESTING OF ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

A. Not Used.

PART 3 - EXECUTION

3.01 GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT

A. Inspect for physical damage and abnormal mechanical and electrical conditions.
B. Any item found to be out of tolerance, or in any other way defective as a result of the required inspection or testing, shall be reported. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.
C. Compare equipment nameplate information with the latest single line diagram and report any discrepancies.
D. Verify proper auxiliary device operation and indicators.
E. Check tightness of accessible bolted electrical joints. Use torque wrench method.
F. Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.
G. Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.
H. Clean All Equipment:
   1. Vacuum inside of panelboards, switchboards, switchgear, fire alarm panels, comm/data, security panel, etc.
   2. Loosen attached particles and vacuum them away.
   3. Wipe all insulators with a clean, dry, lint free rag.
   4. Clean insulator grooves.
   5. Re-vacuum inside surfaces as directed by the WTC Construction Representative or Inspector
I. Inspect equipment anchorage.
J. Inspect equipment and bus alignment.
K. Check all heater elements for operation and control.
L. Lubricate nonelectrical equipment per manufacturer's recommendations.

3.02 GROUNDING SYSTEMS

A. Inspect the ground system for adequate termination at all devices.

3.03 METERING AND INSTRUMENTATION

A. Examine all devices for broken parts, damage and wire connection tightness.
B. Verify the electronic meter is connected properly and displaying proper voltage and power quantities.
C. Inspect nameplate information for compatibility with one-line drawings.
D. Verify the instrument transformer connections with the system requirements.
E. Verify tightness of all bolted connections and assure adequate clearances exist from primary circuits to secondary circuit wiring and to grounds.
F. Verify that all required grounding and shorting connections exist and that those connections have good contact; i.e. sufficient surface area, good cleanliness, and proper pressure.
G. Verify proper primary and secondary fuses and required sizes.

3.04 MECHANICAL AND ELECTRICAL INTERLOCK SYSTEM

A. Physically test each system to insure proper function, operation and sequencing.
B. Closure attempt shall be made on locked open devices.
C. Opening attempt shall be made on locked closed devices.
D. Key exchange shall be made with devices operated in off normal positions.

3.05 DISTRIBUTION PANELBOARDS (LOW VOLTAGE)

A. Visual and Mechanical Inspection:
   1. Inspect for physical, electrical and mechanical conditions. Re-torque all bolted connections.
   2. Compare equipment nameplate information with latest single line diagram and report discrepancies.
   3. Inspect for proper alignment, anchorage and grounding
   4. All doors, panels and sections shall be inspected for paint, dents, scratches, and fit.
   5. Inspect cleanliness
B. Clean distribution panelboard enclosure using the following methods:
   1. Loosen attached particles and vacuum them away.
   2. Wipe all porcelain with a clean, dry, lint-free rag.
   3. Clean all insulator grooves.
   4. Vacuum inside of switchgear enclosure
   5. Lubricate per manufacturer's recommendations.
C. All active components shall be exercised and cleaned where possible.
D. All indicating devices shall be inspected for proper operation.

3.06 CABLES

A. 600 Volt cable:
   1. Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections.
   2. Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor terminations to manufacturer's recommendations.

3.07 PANELBOARDS

A. Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and mechanical bonding. Verify circuit breaker operation. Verify the directory.

3.08 LIGHT FIXTURES

A. Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips. Confirm operation of the fixture with the proper switch or sensor.

3.09 OCCUPANCY SENSORS

A. Confirm operation of the sensor per the manufacturers spec.
3.10 BATTERY PACK EMERGENCY LIGHTING
   A. Verify the operation per the manufacturers spec and run all of the diagnostic steps. Confirm proper grounding and location.

3.11 UPS SYSTEM
   A. Operate and test the system per the manufacturers spec.

3.12 MOTOR STARTERS
   A. Verify the control circuits. Confirm the fusing and the grounding of the control transformers. Torque all of the connections. Confirm the overload elements and the circuit breakers (fuse) for proper sizing. Verify all grounding. Operate and test each motor starter for proper operation.

END OF SECTION 26 05 04
SECTION 26 05 14
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 RELATED WORK
Section 26 05 26 - Grounding and Bonding for Electrical Systems
Section 26 05 29 - Hangers and Supports for Electrical Systems
Section 26 05 53 - Identification for Electrical Systems
Section 26 27 02 – Equipment Wiring Systems

1.02 REFERENCE
A. Applicable provisions of Division 1 govern work under this section.

1.03 REFERENCE STANDARDS
A. ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters

1.04 SUBMITTALS
A. Submit shop drawings and product data under provisions of Division 1, General Conditions of the Contract.
B. Include physical, electrical, and performance characteristics of each variable frequency drive and associated components, including dimensions; weight; input and output performance; voltage, phase, current and overcurrent characteristics; installation instructions; protective features; wiring and block diagrams indicating specified options; electrical noise attenuation equipment where required to meet the criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency versus load and speed curves; and required operating environment.

1.05 OPERATION AND MAINTENANCE DATA
A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.06 EQUIPMENT STARTUP AND AGENCY TRAINING
A. Provide 2 hours of factory training for Electrical Apprenticeship Instructor.

1.07 WARRANTY
A. The warranty shall be for a period of twenty-four (24) months from the date of project Substantial Completion. Further, the warranty shall include all parts, labor, travel time, administrative costs, overhead, travel expenses, technical support and any and all other costs to provide the warranty service.

PART 2 – PRODUCTS

2.01 MANUFACTURERS
A. Toshiba, Allen Bradley, Eaton, Schneider Electric, ABB or equal is accepted.
B. Six (6) Required for this project.
2.02 DESIGN AND CONSTRUCTION

A. VFD drive is for instructional purposes only. It is not intended for any building motor loads.

B. The unit shall be variable torque, modular design for control of the motors as specified in Division 15 and rated at the motor full load nameplate amps.

C. The unit shall be U.L. listed, solid state, micro-processor-based with a pulse width modulated (PWM) output waveform (none others are acceptable).

D. The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT’s) shall be employed as the output switching device.

E. The VFD package shall contain the equivalent of 5% impedance to reduce harmonic distortion. The 5% equivalent impedance shall be provided in the form of a DC bus choke, an input AC line reactor in each phase, or a combination of the two methods.

F. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed circuit boards.

G. Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 90% non-condensing.

H. Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in the same pathway.

I. The unit enclosure shall be NEMA 1 as required for the application minimum and all components shall be fully factory assembled and tested prior to leaving the manufacturing facility.

J. Include the following operating and monitoring devices mounted on the front cover:
   1. A disconnect switch or circuit breaker to de-energize both the drive and bypass circuit with door interlocked handle and lock-open padlocking provisions.
   2. Operating mode selector switch marked "hand-off-auto".

K. Provide a manual bypass circuit and bypass starter to transfer from variable frequency drive operation to bypass operation (Not Required).

L. Provide a 5HP, 208 VAC, 3-Phase, 17.5 full load amps. rated drive or similar.

2.03 PERFORMANCE REQUIREMENTS

A. Units shall be suitable for input power of electrical system as scheduled on the drawings ±10%, 3 phase, 60 Hertz nominal.

B. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.

C. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 6:1 turndown.

D. Additional performance capabilities to include the following:
   1. Ride through a momentary power outage of 15 cycles,
2. Start into a rotating load without damage to drive components or motor,
3. Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage
4. Input power factor: Min 0.95 throughout the speed range
5. Minimum efficiency: 95% at 100% speed, 85% at 50% speed

2.04 CONTROL FEATURES

A. Use control circuits compatible with input signal from temperature control system in the automatic mode and from manual speed control in the manual mode. Vary motor speed in response to the input control signal. Include components necessary to accept the signal from the temperature control system in the form that it is sent. VFD will not be connected to any building motor loads.

B. Include the following additional control features:
1. Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control
2. Analog input, selectable 0-10v or 4-20 mA, for automatic control from the temperature control system
3. Local speed control at the VFD
4. Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjusted
5. Adjustable minimum and maximum speed settings for both automatic and manual modes of operation
6. Field adjustment of minimum and maximum output frequency
7. Two (2) sets of programmable form “C” contacts for remote indication of variable frequency drive condition. Note: default programming to be set for “Drive Run & Fault”.
8. Illuminated display keypad.
9. External Fault indicator
10. One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop
11. One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes, etc). This input shall be factory wired to prevent both the VFD and bypass starter operation when external fault is present.
12. One (1) N.O. dry contact output for proving motor status. This output shall be programmed to detect belt or coupling break that would remove the load from the motor. The dry contact will open on loss of load or VFD being off.
13. PID control loop capable of VFD control from an external device connected to a VFD analog input.

2.05 PROTECTION FEATURES

A. Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:
1. Activation of any safety device;
2. Instantaneous overcurrent and/or over voltage of output;
3. Power line overvoltage and under-voltage protection;
4. Phase loss;
5. Single and three phase short circuiting;
6. Ground faults;
7. Control circuit malfunction;
8. Over-temperature; and

B. Provide the following additional protective features:
1. Input transient overvoltage protection up to 3000 volts per ANSI 37.90A;
2. DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and de-energizes the drive at a predetermined current level;
3. Fusing for the control circuit transformer;
4. Grounded control chassis; and
5. Devices and/or control circuitry to ensure that the variable frequency drive and bypass starter are not both energized and driving motor simultaneously.

2.06 DIAGNOSTICS

A. Provide an English character display (no error codes) with indicators for the following:
1. Phase loss
2. Ground fault
3. Overcurrent
4. Overvoltage
5. Under-voltage
6. Over temperature
7. Overload
8. DC bus status

2.07 QUALITY ASSURANCE TESTS

A. Provide a field performance test to determine proper operation of VFD.

2.08 BYPASS EQUIPMENT (NOT REQUIRED)

2.09 AC INPUT LINE REACTORS (IF REQUIRED)

A. When needed to comply with the requirement for 5% equivalent impedance, furnish and factory install AC input line reactors.

B. Line reactors shall be installed in each phase of the AC input side of the VFD and mounted within a common enclosure with the VFD.

C. Line reactor shall be a three-phase inductor, iron core, 600V, Class H insulation, 115 degree C rise, copper windings with screw type terminal blocks.

PART 3 - EXECUTION

3.01 VARIABLE FREQUENCY DRIVES (SIX REQUIRED)

A. Install in the Six (6) Commercial Electrical Apprenticeship Labs where indicated on drawings and in accordance with approved submittals and manufacturer's published recommendations.

B. Input power wiring shall be installed in a separate conduit, output power wiring shall be installed in a separate conduit and control wiring shall be installed in a separate conduit. Do not mix input power, output power, or control wiring in a common conduit. Separate conduits for input and output power wiring shall be provided for each motor. Input and output power wiring for more than one motor shall not share a common conduit. If provided, do not mount output line filter above the drive.

C. Control signal for drive will be provided under Division 23.
3.02 AGENCY TRAINING

A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 2 hours.

END OF SECTION 26 05 14
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SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE

PART 1 - GENERAL

1.01 RELATED WORK
A. Applicable provisions of Division 1 govern work under this Section.
   Section 26 0533 – Raceway and Boxes for Electrical Systems.
   Section 26 0526 – Grounding and Bonding for Electrical Systems
   Section 26 0553 – Identification for Electrical Systems.

1.02 REFERENCES
A. NFPA 70 - National Electrical Code

1.03 SUBMITTALS
A. Submit product data: Provide for each cable assembly type.
B. Submit factory test reports: Indicate procedures and values obtained.
C. Submit shop drawings for modular wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
D. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.04 PROJECT CONDITIONS
A. Verify that field measurements are as shown on Drawings.
B. Conductor sizes are based on copper.
C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
D. Where wire and cable routing are not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.01 GENERAL
A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
B. All conductors shall be copper. All ground conductors shall be copper.
C. Insulation shall have a 600-volt rating.
D. All conductors shall be stranded.
   1. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.
E. Non-metallic Sheathed Cable (Romex) shall be allowed only in Residential labs (Six Total).

2.02 BUILDING WIRE
A. Description: Single conductor insulated wire 90 degree C.
B. Insulation: Type THHN/THWN-2, XHHW-2 insulation.
C. Non-Metallic Sheathed Cable (Romex), Only allowed in Residential Labs.
2.03 SERVICE ENTRANCE CONDUCTORS

A. Description:
   1. Single conductor or multi-conductor insulated wire. 90 degree C sized at the 75 degree C table.
   2. Provide only for simulated underground service to switchboard #1 located in Electrical Room #120.

B. Insulation:
   1. Type USE-2, XHHW-2 insulation for service entrance conductors routed from exterior source to exterior termination location.
   2. Type XHHW-2 insulation for services entrance conductors routed from exterior source to interior termination location.

C. Aluminum:
   1. Provide Aluminum conductors only as noted on drawings.

2.04 VARIABLE FREQUENCY DRIVE (VFD) WIRE

A. All power wiring from the VFD output to the motor shall be type XHHW-2 insulation, single conductor wire.

2.05 ABOVE GROUND WIRE FOR EXTERIOR WORK

A. Description: Single conductor insulated wire, 90 degree C.
B. Insulation: Type THHN/THWN-2, XHHW-2 insulation.

2.06 UNDERGROUND WIRE FOR EXTERIOR WORK

A. Description: Stranded single or multiple conductor insulated wire, 90 degree C.
B. Insulation: Type XHHW-2, RHW-2 insulation.
C. This wiring shall be used in all underground feeder and branch circuit applications.

2.07 WIRING CONNECTORS

A. Split Bolt Connectors: Not acceptable.
B. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment terminals. Not approved for splicing.
C. Twist Type Wire Connectors: Solderless twist type spring connector (wire-nut) with insulating cover for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller. The manufacturer's wire fill capacity must be followed.
D. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations. Gel filled twist type connectors can be used for copper conductor sizes 6 AWG and smaller for site lighting applications. The manufacturer’s wire fill capacity must be followed.
E. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.
F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps. Connector must be installed with a crimper tool listed for use with the manufacturer and type of compression connector.

PART 3 - EXECUTION

3.01 GENERAL WIRING METHODS

A. All wire and cable shall be installed in conduit.
B. Do not use wire smaller than 12 AWG for power and lighting circuits.
C. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductors for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

D. Make conductor lengths for parallel conductors equal.

E. Splice only in junction or outlet boxes.

F. No conductor less than 12 AWG shall be installed in exterior underground conduit.

G. Identify ALL low voltage wire, 600V and lower, per section 26 05 53.

H. Neatly train and lace wiring inside boxes, equipment, and panelboard.

3.02 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use Listed water or silicone based wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary. Wax based lubricants are not allowed. Pulling lubricant is not required for low friction type products where the cable manufacturer recommends that cables be pulled without lube.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

E. VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power and output power, or control wiring in a common raceway.

F. In high ambient spaces, mechanical rooms, utility rooms and exterior exposed conduit, 90-degree C conductors shall be utilized.

3.03 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible junction boxes.

B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.

C. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.

D. Use solderless twist type spring connectors (wire nuts) with insulating covers for wire splices and taps, 10 AWG and smaller.

E. Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the wiring.

F. Thoroughly clean wires before installing lugs and connectors.

G. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 26 05 04.

3.05 WIRE COLOR

A. General:

1. Solid colored insulation is required for all THHN/THWN-2 wire. For other wire types use colored wire or identify wire with colored tape at all terminals, splices and boxes. Wire shall be colored as indicated below.

2. In existing facilities, use existing color scheme.

3. In new facilities, use black and red for single phase circuits at 120/240 volts, use Phase A black, Phase B red and Phase C blue for circuits at 120/208 volts single or three phase, and use Phase A brown, Phase B orange and Phase C yellow for circuits at 277/480
volts single or three phase. Note: This includes fixture whips except for Listed whips mounted by the fixture manufacturer on the fixture and Listed as a System.

4. All switch legs shall be the same color as their associated circuit. Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.

B. Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with a different stripe.

C. Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.

D. Feeder Circuit Conductors: Each phase shall be uniquely color coded.

E. Ground Conductors: Green colored insulation for THHN/THWN-2 wire. For other wire types use green colored wire or identify wire with green tape at both ends and at all access points, such as panelboards, motor starters, disconnects and junction boxes. When isolated grounds are required, contractor shall provide green with yellow tracer.

3.06 BRANCH CIRCUITS

A. The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All single-phase branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.
SECTION 26 05 23
CONTROL-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
   Section 26 05 33 – Raceway and Boxes for Electrical Systems.
   Section 26 05 53 – Identification for Electrical Systems.

1.02 REFERENCES

A. NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

A. Submit product data: Provide for each cable assembly type.
B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of
   use stipulated by product testing agency specified under Regulatory Requirements.

1.04 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.
B. Conductor sizes are based on copper.
C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire
   and cable as required to meet Project Conditions.
D. Where wire and cable routing are not shown, and destination only is indicated, determine exact
   routing and lengths required.

PART 2 - PRODUCTS

2.01 GENERAL

A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year
   old out of manufacturer's stock.
B. All conductors shall be copper.
C. Insulation shall have a 600-volt rating.
D. All conductors must be suitable for the application intended. Conductors #12 and smaller may
   be solid or stranded with the following requirements or exceptions:
   1. All conductors terminated with crimp type devices must be stranded.
   2. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or
      methods: e.g. stranded conductors may not be wrapped around a terminal screw but
      must be terminated with a crimp type device or must be terminated in an approved back
      wired method.
   3. All low voltage cables shall be PLENUM rated.

2.02 REMOTE CONTROL AND SIGNAL CABLE

A. Refer to Section 28 31 00 for requirements for cable to be used on fire alarm systems.
B. Refer to Section 27 00 00 for requirements for cable to be used for Telecommunication
   systems.
C. All other systems cabling shall meet the requirements of NEC Article 725 and the following:
   1. Control Cable for Class 1 Remote Control and Signal Circuits: 600-volt insulation,
      individual conductors twisted together and covered with an overall PVC jacket. Cable
shall be Listed, temperature rated, and plenum or non-plenum rated for the application as required in the National Electrical Code.

2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, Listed, temperature rated, and plenum or non-plenum rated for the application as required in the National Electrical Code.

2.03 WIRING CONNECTORS

A. Split Bolt Connectors: Not acceptable.
B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

PART 3 - EXECUTION

3.01 GENERAL WIRING METHODS

A. Low voltage control and signal cables shall be installed in conduit. However, they may be installed without conduit above accessible ceilings if the cable meets NEC requirements for the application, unless specified to be in conduit in other sections of the specifications. See requirements for free-air cabling installation below.
B. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts, all sizes subject to NEC 725 requirements.
C. Splice only in junction boxes.
D. Identify wire per section 26 05 53.
E. Neatly train and lace wiring inside boxes, and equipment.

3.02 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling conditions when necessary.
B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.03 FREE-AIR CABLE INSTALLATION (ABOVE SUSPENDED CEILING ONLY)

A. Cabling shall be neatly run at right angles and be kept clear of other trades work.
B. Cabling shall be supported at a maximum of 4-foot intervals utilizing ‘bridal-type’ mounting rings anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Mounting rings shall be designed to maintain cables bend to larger than the minimum bed radius (typically 4 x cable diameter).
C. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical or communications conduit. Additionally, cabling shall not be laid directly on the ceiling grid.
D. To reduce or eliminate Electro-Magnetic Interference (EMI), the following minimum separation distances for ‘Free-Air’ cabling installations shall be adhered to:
   1. Twelve (12) inches from power lines of less than 5kV.
   2. Thirty-nine (39) inches from power lines of 5kV or greater.
   3. Eighteen (18) inches from lighting fixtures.
   4. Thirty-nine (39) inches from transformers and motors.
E. A coil of 4 feet in each cable shall be placed in the ceiling at each ‘free-air’ wired device. These coils shall be secured (wire tied) at the last cable support before the cable reaches the device and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
F. All cable shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.

G. Cable manufacturers minimum bend radius shall be observed in all instances. Care should be taken in the use of cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.

H. All exposed vertical cable extensions to devices located below the finished ceiling shall be in conduit.

I. Provide protection for exposed cables where subject to damage.

J. Use suitable cable fittings and connectors.

3.04 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible junction boxes (except splices to low voltage occupancy sensor power packs and terminations to temperature control devices).

B. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.

C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.

D. Thoroughly clean wires before installing lugs and connectors.

E. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 26 05 04.

END OF SECTION 26 05 23
SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.02 REFERENCES

NFPA 70 - National Electrical Code
ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems
UL 467 Electrical Grounding and Bonding Equipment
IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding
ANSI J-STD-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA/EIA-606-A - Administration Standard for Commercial Telecommunications Infrastructure

1.03 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance:
1. Equipment Rated 500 KVA and Less: 10 ohms maximum at building service entrance.
2. Equipment Rated 500 to 1000 KVA: 5 ohms maximum at building service entrance.
3. Equipment Rated more than 1000 KVA: 3 ohms building service entrance.

1.04 SUBMITTALS

A. Product Data: Provide data for grounding electrodes and connections.
B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
C. Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately record locations of all ground rods and other grounding electrodes. (Not required for this project)

1.06 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.01 ROD ELECTRODE

A. Material: Copper-clad steel.
B. Diameter: 5/8-inch minimum for Residential labs, ¾” inch for commercial work.
C. Length: 8 feet (3.5 m) minimum for residential labs, 10 feet for commercial work. Rod shall be driven as directed by Electrical Apprenticeship Instructor. Twelve (12) residential ground rods
required for this project (2 for each Residential Lab). Two (2) commercial ground rods required for switchboard #1 located in electrical room #120.

2.02 CONCRETE-ENCASED GROUNDING ELECTRODE (Not Required)
A. Fabricate per NFPA 70, Article 250.52 (A)(3) using 20 feet (6m) of bare copper wire not smaller than #4 AWG. If concrete foundation is less than 20 feet (6m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

2.03 MECHANICAL CONNECTORS
A. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.
B. Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.
C. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

2.04 COMPRESSION CONNECTORS
A. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.
B. Each connector shall be factory filled with an oxide-inhibiting compound.
C. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.
D. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.
E. The installation of the connectors shall be made with a compression tool and die system, as recommended by the manufacturer of the connectors, and shall be irreversible.
F. Pre-crimping of the ground rod is required for all irreversible compression connections to a ground rod.
G. Terminal lug for communication system grounding shall be compression type and conform to the following:
   1. Material: Tin Plated Copper (aluminum not permitted).
   2. Wire Size: to match conductor
   3. Number of Stud Holes: 2
   4. Stud Hole Size: 3/8”
   6. Tongue Angle: Straight

2.05 EXOTHERMIC CONNECTIONS (Not Required)
A. As manufactured by Cadweld or similar.

2.06 CONDUCTORS
A. Material: Stranded copper (aluminum not permitted).
B. Grounding Electrode Conductor: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger.
C. Foundation Electrodes: As shown on drawings.
D. Primary Manhole, Main Switchgear room and Vault Bonding: No. 4/0 minimum.
E. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used at the same facility.

F. Conductors for Telecommunications shall be as follows:
   1. Telecommunications Equipment Rack Conductor No. 6 minimum or as shown on drawings.

2.07 BUS/BUSBAR

A. Material: Copper (aluminum not permitted).

B. Size: All Power systems: 1/4" X 2", length as needed.
   1. Telecommunications Main Ground Busbar (TMGB): 1/4" x 4" x 20" long (minimum).
   2. Telecommunications Grounding Busbar (TGB): 1/4" x 2" x 12" long (minimum).

C. Busbars for Telecommunications shall:
   1. Be pre-drilled to accommodate two-hole lugs.
   2. 3/8" stud hole size; hole spacing per ANSI J-STD-607-A.
   3. Incorporate insulators and stand-off brackets that electrically isolate busbar from mounting surface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 GENERAL

A. Install Products in accordance with manufacturer's instructions.

B. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

C. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

D. Attach grounds permanently before permanent building service is energized.

E. Terminate each grounding conductor on its own terminal lug. Sharing a single lug by multiple conductors is not allowed.

F. All grounding electrode conductors and individual grounding conductors shall be installed in PVC conduit, in exposed locations.

3.03 LESS THAN 600 VOLT ELECTRICAL SYSTEM GROUNDING

A. Supplementary Grounding Electrode: Use driven ground rod on exterior of building. Use effectively grounded metal frame of the building.

B. Provide code sized copper grounding electrode conductor from secondary switchboard ground bus, each separately derived system neutral, secondary service system neutral to street side of water meter, building steel, ground rod, and any concrete encased electrodes. Provide bonding jumper around water meter.

C. Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

D. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

E. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to under floor ground grid. Use #4 AWG bare copper conductor.
3.04  FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

3.05  IDENTIFICATION AND LABELING

A. Label Grounds at point of termination.

END OF SECTION 26 05 26
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.02 SUBMITTALS

A. Product Data: Provide data for support channel.

1.03 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Support Channel: Steel, Galvanized, Enameled or other corrosion resistant.
B. Hardware: Corrosion resistant.
C. Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and larger, and ¼" for single conduits 1" and smaller.
D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. 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.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).
B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.
C. Powder-actuated fasteners and plastic wall anchors are not permitted. Compressed-air power-actuated fasteners may ONLY be used for the installation of separate ceiling wires required for support of conduits and aircraft cable hung light fixtures.
D. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.
E. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.
F. Do not drill structural steel members unless approved by Structural Engineer.
G. Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
H. In mechanical rooms and electrical rooms install free-standing electrical equipment on 3.5-inch (89 mm) concrete pads (minimum).
I. Install surface-mounted cabinets and panelboards with a minimum of four anchors. At all cabinet and panelboard locations on concrete or concrete block walls, and at ALL locations below grade, provide steel channel supports to stand cabinet one inch (25 mm) off wall (7/8”
Uni-strut or ¾” painted, fire-retardant plywood is acceptable). In above-grade equipment rooms that have drywall walls, the cabinets and panelboards may be mounted to the drywall if backing is provided in the stud walls behind the equipment.

J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

K. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION 26 05 29
SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

   A. Applicable provisions of Division 1 govern work under this section.
      Section 26 05 29 – Hangers and Supports for Electrical Systems.
      Section 26 27 02 – Equipment Wiring Systems.
      Section 26 27 26 – Wiring Devices.
      Section 28 31 00 – Fire Detection and Alarm.

1.02 SUBMITTALS

   A. Surface Raceway System - submit product data and catalog sheets for all components.
   B. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's
      instructions.

PART 2 - PRODUCTS

2.01 RIGID METAL CONDUIT (RMC) AND FITTINGS

   A. Conduit: Heavy wall threaded, galvanized steel, schedule 40.
   B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.02 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

   A. Conduit: Steel, galvanized tubing.
   B. Fittings: All steel, set screw, concrete tight. No push-on or indenter types permitted.
   C. Conduit Bodies: All steel threaded conduit bodies.
   D. Pre-painted ‘RED’ for fire alarm system raceway.

2.03 FLEXIBLE METAL CONDUIT (FMC) AND FITTINGS

   A. Conduit: Steel, galvanized, spiral strip.
   B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in
      specification 26 51 13).

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS

   A. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-
      resistant jacket.
   B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic
      cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

2.05 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

   A. Conduit: Rigid non-metallic conduit, Schedule 40 PVC minimum, Listed, sunlight resistant,
      rated for 90° C conductors.
   B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

2.06 CONDUIT SUPPORTS

   A. See section 26 05 29.
2.07 PULL AND JUNCTION BOXES

A. Interior Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot-welded joints and corners.
B. Interior Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
C. Exterior Boxes and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain tight.
D. Fiberglass, Quazite or Concrete Handholes with weatherproof cover of non-skid finish shall be used for underground installations. Cover shall identify system serviced.
E. Box extensions and adjacent boxes within 48” of each other are not allowed for the purpose of creating more wire capacity.
F. Junction boxes 6” x 6” or larger size shall be without stamped knock-outs.
G. Wireways shall not be used in lieu of junction boxes.

2.08 OUTLET BOXES

A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8-inch male fixture studs where required.
C. Concrete Ceiling Boxes: Concrete type.
D. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.
E. Provide residential PVC type junction boxes in Residential Labs only.

2.09 GENERAL

A. All steel fittings and conduit bodies shall be galvanized.
B. No cast metal, or split-gland type fittings permitted.
C. Mogul-type condulets larger than 2-inch (50 mm) not permitted except as approved or detailed.
D. All conduit covers must be fastened to the conduit body with screws and be of the same manufacture.
E. Wireways, gutters and c-condulets shall not be used in lieu of pull boxes and condulets.
F. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

PART 3 - EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. EMT is permitted to be used in sizes 4" (50 mm) and smaller for power and low-voltage systems.
B. Size power conductor raceways for conductor type installed. Conduit size shall be ½-inch (16 mm) minimum except all homerun conduits shall be ¾" (21 mm), or as specified elsewhere. Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.
C. Minimum size for raceway for communications, control, security, fire alarm, signal, video and other low-voltage applications shall be 3/4 inch, unless otherwise noted on drawings.
D. Provide one raceway from each communications outlet box to above accessible ceiling as detailed on drawings.
E. Arrange conduit to maintain headroom and present a neat appearance.
F. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
G. Maintain minimum 6-inch (150 mm) clearance between conduit and piping. Maintain 12-inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
H. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.

I. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

J. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.

K. Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.

L. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.

M. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.

N. For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.

O. All conduits installed in exposed areas shall be installed with a box offset before entering box.

3.02 CONDUIT INSTALLATION

A. Cut conduit square; de-burr cut ends.

B. Conduit shall not be fastened to the corrugated metal roof deck.

C. Bring conduit to the shoulder of fittings and couplings and fasten securely.

D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.

E. Terminate all conduit (except for terminations into conduit bodies) using conduit hubs, or connectors with one locknut, or shall use double locknuts (one each side of box wall) and insulated bushing. Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.

F. Install no more than the equivalent of:
   1. Three 90-degree bends between boxes for electrical systems.
   2. Two 90-degree bends between boxes for communications and other low voltage systems.

G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch (50 mm) size unless sweep elbows are required.

H. Bend conduit according to manufacturer’s recommendations. Torches or open flame shall not be used to aid in bend of PVC conduit.

I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.

J. Provide 1/8-inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.

K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the manufacturer.

L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.

M. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.

N. Route conduit through roof openings for piping and ductwork where possible.

O. Where communication cabling is to be installed in conduit to the wiring hub (e.g. Telcom Room), multiple conduits may be consolidated into fewer, larger conduits. Capacity of shared conduits shall equal the capacity of the individual conduits unless otherwise noted. Electrical Contractor is responsible for sizing of conduit for all low-voltage systems.

P. Use U.L. listed metallic grounding clamps when terminating conduit to cable tray.

Q. Ground and bond conduit under provisions of Section 26 05 26.
R. Conduit is not permitted in any slab topping of two inches (50 mm) or less.
S. Maximum Size Conduit in Slabs Above Grade: 3/4 inch (19 mm). Do not route conduits to cross each other in slabs above grade.
T. Identify conduit under provisions of Section 26 05 53.
U. All conduit installed underground (exterior to building) shall be buried a minimum of 24” below finished grade, whether or not the conduit is concrete encased.
V. Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement shall match weather condition. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturer's recommendations.

3.03 CONDUIT INSTALLATION SCHEDULE

A. Conduit other than that specified below for specific applications shall not be used.
2. Under Slab on Grade Installations: Rigid metal conduit. Schedule 40 PVC conduit.
5. Concealed in Block Walls: Electrical metallic tubing, Schedule 40 PVC conduit.
6. Within Concrete Slab: Rigid Metal conduit. Schedule 40 PVC conduit.
7. Wet Interior Locations: Rigid metal conduit, Schedule 40 PVC conduit.
8. Concealed Dry Interior Locations: Rigid metal conduit. Electrical metallic tubing. Flexible Metallic Tubing, MC cable with permission from WTC Facility Department for specialty areas only.
10. Motor and equipment connections: Liquidtight flexible metal conduit (LFMC) (all locations). Minimum length shall be one foot (300 mm), maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
11. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" (10 mm) minimum diameter and six foot (1.8 M) maximum length. Conduit length shall allow movement of fixture for maintenance purposes.

3.04 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of outlets in offices, classroom and work areas prior to rough-in.
C. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.
D. Conduit and boxes shall not be fastened to the metal roof deck. If conduit and boxes are required to be located and installed on roof decks, the conduit and boxes are required to be spaced minimum 1-5/8" off the lowest part of the metal roof decking material, per NEC 300.4 (E).
E. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
F. In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.
G. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.
H. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18-inch (450 mm) by 24-inch (600 mm) access doors. Boxes must be installed within 12" from edge of the access door.
I. Locate and install to maintain headroom and to present a neat appearance.

J. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.05 PULL AND JUNCTION BOX INSTALLATION

A. Pull boxes and junction boxes shall be minimum 4-inch square (100 mm) by 2 1/8 inches (54 mm) deep for use with 1-inch (25 mm) conduit and smaller. On conduit systems using 1-1/4-inch (31.75 mm) conduit, minimum junction box size shall be 4 11/16” by 2-1/8” deep.

B. Where used with raceway(s) of larger than 1¾” trade size or larger, pull box shall be sized as follows unless otherwise noted on the drawings:
   1. For straight pull through, have a length of at least 8-times trade-size diameter of largest raceway;
   2. For angle and U pulls:
      a. Have a distance between each raceway entry inside box and opposite wall of box of at least 6-times trade-size diameter of largest raceway, this distance being increased by sum of trade-size diameters of other raceways on same wall of box; and
      b. Have a distance between nearest edges of each raceway entry enclosing same conductor of at least six times trade-size diameter of raceway; or six times trade-size diameter of larger raceway if they are of different sizes.

C. For a raceway entering wall of a pull box opposite to a removable cover, have a distance from wall to cover of not less than trade-size diameter of largest raceway plus 6-times diameter of largest conductor.

D. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.

E. Provide Pull and Junction boxes for communications and other low voltage applications (a) in any section of conduit longer than 100 feet, (b) where there are bends totaling more than 180 degrees between pull points or pull boxes and (c) wherever there is a reverse bend in run. Locate boxes on straight section of raceway (e.g. do not use boxes in place of raceway bends).

3.06 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls. Provide minimum 6-inch (150 mm) separation, except provide minimum 24-inch (600 mm) separation in acoustic-rated walls.

B. Power:
   1. Recessed (1/4” maximum) outlet boxes in masonry, concrete, tile construction, or drywall shall be minimum 4-inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes. A single gang box can be used in drywall and masonry, for a single device location, when a single conduit enters box.
   2. Shallow 4x4x1-1/2” deep boxes can be used as device boxes for power provided the box and plaster ring is sized for installed device and conductors.

C. Low Voltage:
   1. Recessed (1/4” maximum) outlet boxes in masonry, concrete, tile construction or drywall shall be minimum 4-inch square, 2-1/8” deep with single gang device ring (unless noted otherwise on drawings). Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
   2. Provide one conduit from each communications outlet box. Conduit runs between outlet boxes for communications are not allowed. In general, terminate conduit above accessible ceiling in corridor on cable tray unless noted otherwise. The intent is to provide a conduit path between the low voltage junction box and the cable tray.
D. Provide knockout closures for unused openings.
E. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.
F. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.
G. Install boxes in walls without damaging wall insulation.
H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
I. Ceiling outlets shall be 4-inch square, minimum 2-1/8 inch (54 mm) deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.
J. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed luminaire, to be accessible through luminaire ceiling opening.
K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
L. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
M. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.
N. Surface wall outlets shall be 4-inch (100 mm) square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

END OF SECTION 26 05 33
SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK
A. Applicable provisions of Division 1 govern work under this Section.
B. Section 26 05 29 - Hangers and Supports for Electrical Systems

1.02 REFERENCES

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1.03 SUBMITTALS
A. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.
B. Product Data: Provide data for tray sections, connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps, hold-down plates, support hardware, and accessories.
C. Detailed sketch of proposed method(s) of installation.
D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

PART 2 - PRODUCTS

2.01 WIRE BASKET CABLE TRAY and COMPONENTS
A. Description: Continuous, rigid, welded steel wire mesh cable support system.
B. Material: Carbon steel wire, ASTM A510, Grade 1008. Wire shall be welded, bent and surface treated after manufacture.
C. Finish: Electro-Plated Zinc Galvanizing per ASTM B633, Type III, SC-1 or Electro-plated yellow zinc dichromate in accordance with ASTM B633 SC2.
D. Wire diameter shall be 0.195" (5mm) minimum on all mesh sections up to 16 linear inches. Wire diameter shall be 0.234" (6mm) minimum on all mesh sections in excess of 16 linear inches.
E. Wire Mesh to be welded at all intersections. Each wire end shall be rounded along tray sides for safe handling and to protect cables from damage.
F. All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be T-welded on all tray sizes.
G. Dimensions:
   1. Mesh Dimension: 2 x 4 inches.
   2. Inside Width: 12 inches.
   3. Inside Depth: 4 inches.
H. Bends/Reducers/Tees/Horizontal and Vertical Offsets: These may be factory manufactured or field fabricated in accordance with manufacturer's instructions.
I. Provide manufactured "Radius shield" for a smooth inside radius surface.
J. Support System: To be part of a system incorporating mechanisms for wall installation, trapeze, center support, or under-floor mounting. Supports shall comply with product requirements defined in specification section 26 05 29.
K. Hardware: Hardware, including splice connectors and support components, shall be furnished by cable tray manufacturer.
L. Grounding: Assembled tray shall be UL classified as an equipment grounding conductor.
M. WARNING LABELS: Engraved or printed nameplates shall include the following or similar language:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install metallic cable tray in accordance with NEMA VE-1 and VE-2.
C. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps as required.
D. Conduit connections to the tray shall be made with an U.L. approved clamps, manufactured specifically for the purpose.
E. Coordination
   1. The Contractor shall coordinate the installation of the cable tray with plumbing and HVAC Contractors so that clearance is maintained between the cable tray and other trade's work. This clearance shall be a minimum of one (1) foot on both sides of the cable tray (one side if wall mounted) and eight (8) inches on top of the cable tray. Tray shall not restrict removal of ceiling panels nor lighting assemblies. If these conditions cannot be met, this Contractor shall notify the WTC Representative for clarification and direction before proceeding with installation.
   2. Do not install cable tray below re-heat coils, traps, etc. In those areas that have no option furnish and install a manufacturer approved cover extending 12" on either side.
F. Clearances
   1. Minimum separation distances between communications wires and cables, and any electric light, power, Class 1, non-powered fire alarm, or medium power network-powered broadband communications circuit shall comply with NEC Article 800.
   2. In addition, to reduce or eliminate EMI, the following minimum separation distances shall be adhered to:
      a. Thirty-nine (39) inches from transformers and motors.
      b. Balanced twisted-pair cabling installed in cable tray shall be separated from fluorescent lamps and associated fixtures by a minimum of 5 inches (125 mm).
c. Zero pathway separation distance is permitted when the electrically conductive telecommunications cables, the power conductors or both are enclosed in metallic pathways that meet the following conditions:

d. the metallic pathway(s) completely enclose the power conductors and are continuous;

e. the metallic pathway(s) are properly bonded and grounded per ANSI/TIA-607-B; and

f. the walls of the pathway(s) have a minimum thickness 1 mm (0.04 in) nominal if made of steel (1/2" EMT minimum)

g. No separation is required between power and telecommunications cables crossing at right angles.

G. Support

1. No conduit shall be attached to the cable tray except for the conduits that terminate at the cable tray. Cable tray supports can be used to support conduit. Do not use more than 1/2 of the cable tray support for conduit support.

2. Support trays in accordance with Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 ft (2.5 m) maximum.

3. All of the threaded rod used for the tray support shall be 3/8" diameter for 12" wide tray and 1/2" minimum for tray larger than 12" wide.

4. Where a single Center Support is used for 12" wide tray, threaded rod shall be 1/2".

5. Bolts and nuts shall be installed in all holes of the cable tray splice plates per the manufacturer’s instructions for installation.

6. Tray support shall be installed in a trapeze, wall angle, or center support configuration as shown on the plans, outlined in the spec and approved by the project engineer. Center support is allowed on 12" wide and less cable tray.

7. Supports shall be formed shape channel trapeze members per section 26 05 29, or formed mounting assemblies that are part of the manufacturer’s integrated cable tray system, complete with nuts, bolts, washers, lock washers and tray clamps as required for a complete and finished installation.

8. Submit complete detailed sketch(es) for approval of the actual proposed method(s) of installation.

9. The maximum allowable deviation of the tray, from the level horizontal plane measured across the width of the tray, is one half of one inch (1/2"), with the tray loaded to capacity, as allowed by the NEC.

10. The approval of the installation method does not relieve this contractor from meeting the above deviation requirement. If additional support is needed, as determined by the project engineer, this contractor shall furnish and install the additional support at no additional cost to the State.

H. Fittings and Hardware

1. Use manufactured expansion fittings where required at the building expansion joints and as required by the manufacturer.

2. Nuts, bolts, washers, rod, etc. shall be plated.

3. Provide End-of Run Drop-out (4-inch radius; minimum) at terminus of cable tray at equipment room(s) and wherever tray is discontinuous and there is a change in height.

4. Provide threaded rod protector sleeves over all threaded rod supporting the tray. Protectors shall extend above the tray a minimum of eight (8) inches.

I. Grounding and Bonding

1. Ground and bond cable tray under provisions of Section 26 05 26.

2. Provide electric continuity between tray components. Provide manufacturer’s grounding clamps as required. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly if required by the manufacturer. Assembled tray shall be U.L. classified as an equipment grounding conductor.

3. Provide #4 AWG bare stranded copper equipment grounding conductor through entire length of tray. Bond equipment ground conductor to each component, each tray section, and connect to the main building equipment grounding conductor. Equipment grounding
conductor is not required in telecommunications applications provided that the tray is U.L. Listed for grounding.

4. Bond cable tray to the telecommunication grounding bar or conductor in each equipment room (#6 AWG minimum).

5. Equipment grounding conductor connections to the tray shall be made using a U.L. listed mechanical connection. Sheet metal or TEK screws shall not be used for grounding. Split bolts may be used for connection to wire-basket type trays.

J. Penetrations

1. Where cable tray is to penetrate a fire rated wall or floor, the following installation method shall be used by this contractor:
   a. Stop the tray at the penetration and fasten the tray end to the wall/floor.
   b. For every 6" of tray width, furnish and install a 4" rigid galvanized nipple, threaded at both ends, through the penetration extending 4" beyond both sides and supported per section 26 05 29.
   c. Provide a fiber or plastic bushing on one end and ground bushing on the other end.
   d. Bond each grounding bushing to the equipment grounding conductor (or cable tray, if it is U.L. classified as an equipment grounding conductor) with a minimum #6 stranded copper wire using an U.L. listed connector.
   e. Completely seal around the conduits with an U.L. listed fire rated assembly appropriate for penetration.
   f. Completely seal the conduits that have conductors and cables passing through, with a U.L. approved fire rated sealant (putty or pillows).
   g. Close off the unused conduits with a 14 Ga. steel plug held in place by the above required bushings.

K. Warning Signs

1. Provide warning signs at 15-foot intervals along cable tray. Adjust labeling interval to ensure that signs are visible.

L. Field Fabricated Corners, Offsets, or Reducers

1. Where Wire Basket Tray corners, offsets, or reducers are field fabricated, cut wires:
   a. In accordance with manufacturer’s instructions.
   b. Using side action bolt cutters to ensure integrity of galvanic protective layer.
   c. With one clean cut to eliminate grinding and/or touch-up.
   d. Ensure that no sharp edges remain after field fabrication

END OF SECTION 26 05 36
PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this section.
   Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
   Section 26 05 23 – Control-Voltage Electrical Power Cables
   Section 26 05 33 - Raceway and Boxes for Electrical Systems
   Section 26 24 13 - Switchboard
   Section 26 24 16 - Panelboards
   Section 26 27 26 - Wiring Devices
   Section 26 27 28 - Disconnect Switches
   Section 26 29 00 - Low Voltage Controllers
   Section 27 00 00 - Communication Equipment and Cabling
   Section 28 31 00 - Fire Detection and Alarm

1.02 SUBMITTALS

A. Include schedule for nameplates.
B. Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8 1/2” x 11” sheets annotated, explaining their purposed use.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED.
B. All wiring labels shall be white/transparent vinyl or vinyl-cloth, self-laminating, wraparound type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
C. Tape (wiring phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.
D. Nameplates: Engraved three-layer laminated plastic. Normal system shall use nameplates with black letters on white background.
E. Adhesive type labels not permitted except for identification of wires, wiring devices (device plates), 8” square and smaller junction boxes, and control devices.
F. See Junction and Pullbox Identification and Wiring Device Identification sections for allowed usage of permanent marker.

PART 3 - EXECUTION

3.01 GENERAL

A. All branch circuit and power panels shall be identified with the same symbol used in circuit directory in main distribution center.
B. Clean all surfaces before attaching labels with the label manufacturer’s recommended cleaning agent. Install all labels firmly as recommended by the label manufacturer. Labels shall be installed plumb and neatly on all equipment.
C. Install nameplates parallel to equipment lines.
D. Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.
E. Embossed tape will not be permitted for any application.
F. Provide a sign at each service disconnect indicating “Service Disconnect”, and locate above the main switch or circuit breaker, per NEC 230.70(B).

3.02 JUNCTION AND PULLBOX IDENTIFICATION

A. The following junction and pullboxes shall be identified utilizing spray painted covers:

<table>
<thead>
<tr>
<th>System</th>
<th>Color(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Power – 208Y/120V, 240/120V</td>
<td>White</td>
</tr>
<tr>
<td>Fire Alarm</td>
<td>Red</td>
</tr>
<tr>
<td>Temperature Control</td>
<td>Green</td>
</tr>
<tr>
<td>Door Control and Door Monitoring System</td>
<td>Orange</td>
</tr>
<tr>
<td>Sound and Intercom Systems</td>
<td>Gray</td>
</tr>
<tr>
<td>Video Surveillance System</td>
<td>Yellow</td>
</tr>
<tr>
<td>Data</td>
<td>Blue</td>
</tr>
</tbody>
</table>

B. Additional required junction and pullbox identification shall include:
1. Provide circuit numbers and source panel designations for power wiring junction boxes. Other system junction boxes shall be identified as shown on details or approved shop drawings. Temperature control boxes shall identify the source.
2. Where exposed, junction boxes larger than 8” square shall utilize engraved nameplates with ½” minimum letter height. Identify system source(s) and load(s) served.
3. Where exposed, 8” square and smaller junction boxes shall utilize machine generated, adhesive labels.
4. Where located above an accessible ceiling, junction boxes shall utilize machine generated adhesive labels.

3.03 COMMUNICATION CONDUIT LABELING

A. All conduits installed between Telecommunication Equipment Rooms shall be clearly labeled in accordance with ANSI/TIA/EIA-606. Both ends of the conduits shall be labeled.
B. All labels shall be mechanical, no hand written labels.
C. The label shall indicate the location of the far end of the conduit run and a unique conduit number. (i.e. TR-1A-01 or Room #216 – 01).

3.04 POWER, CONTROL AND SIGNAL WIRE IDENTIFICATION

A. Provide wire labels on each conductor 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 wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control and signal wiring.
B. All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated including wiring used for temporary purposes.

3.05 WIRING DEVICE IDENTIFICATION

A. Wall switches, receptacles, occupancy sensors, wall dimmers, device plates and box covers, photocells, and time clocks shall be identified with circuit numbers and source (ex. Panel ABC-3). In exposed areas, identifications should be made outside of device covers, unless directed otherwise. Use machine-generated adhesive labels. For wiring devices such as but not limited to duplex, double duplex and single receptacles MUST have machine generated adhesive label on device cover plate identifying branch circuit and panelboard. NO EXCEPTIONS.
3.06 NAMEPLATE ENGRAVING FOR ELECTRICAL EQUIPMENT

A. Provide nameplates of minimum letter height as scheduled below.
B. Distribution Panelboards, Branch Panelboards, and Switchboards: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source.
C. Circuit Breakers, Switches, and Motor Starters in Distribution Panelboards, and Switchboards; 1/2 inch (13 mm); identify circuit and load served, including location.
D. Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: ½ inch (13 mm); identify source and load served.

3.07 PANELBOARD DIRECTORIES

A. Typed directories for panels must be covered with clear plastic, and have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

END OF SECTION 26 05 53
PART 1 - GENERAL

1.01 RELATED WORK
A. Applicable provisions of Division 1 govern work under this Section.

1.02 REFERENCES
NEMA TP-1
EPACT 2005

1.03 SUBMITTALS
A. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.04 OPERATION AND MAINTENANCE DATA
A. All operations and maintenance data shall comply with the submission and content requirements specified under Division 1.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Store and protect equipment in a dry location with uniform temperature. Cover ventilating openings to keep out dust.
B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.01 DRY TYPE GENERAL PURPOSE TRANSFORMERS
A. Dry Type General Purpose Transformers: Factory-assembled, air cooled, dry type general purpose two winding transformers; ratings as shown on the Drawings.
B. Transformers shall meet the energy efficiency requirements of the Energy Policy Act of 2005. Efficiency shall be no less than the Class 1 efficiency levels listed in Table 4-2 of NEMA Standard TP-1-2002.
C. Insulation system shall be rated at 220 degrees C.
D. Winding temperature rise shall be rated at 150 degrees C above a 40 degree C ambient.
E. Case temperature shall not exceed 50 degrees C rise above a 40 degrees C ambient at its warmest point.
F. Winding Taps, Transformers 15 KVA and Larger: Four 2-1/2 percent taps, two above and two below rated voltage, full capacity taps on primary winding.
G. Sound Levels: Maximum sound levels shall be as follows:

<table>
<thead>
<tr>
<th>KVA Rating</th>
<th>Sound Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>40 dB</td>
</tr>
<tr>
<td>10-50</td>
<td>45 dB</td>
</tr>
<tr>
<td>51-150</td>
<td>50 dB</td>
</tr>
</tbody>
</table>
PART 3 - EXECUTION

3.01 INSTALLATION

A. Set transformer plumb and level.
B. Install on Unistrut framing channel or similar in Commercial Labs as noted on drawings.
C. Use flexible conduit, 2 ft. (0.6 m) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure. Conduit entry can be in the bottom of the transformer in locations where PVC conduit is used in slab on grade, - provide a PVC connector and bushing, or bell ends, on each conduit entry. Coordinate conduit installation with submittals and shop drawings for the transformer.
D. Mount transformers on vibration isolating pads installed between the floor and the transformer, suitable for isolating the transformer noise from the building structure.
E. Provide sufficient space around transformer for cooling as recommended by the manufacturer. Provide a minimum space of 12” between the transformer and any wall.

3.02 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.
B. Measure primary and secondary voltages and make appropriate tap adjustments within 2-1/2% of the normal operating load after the building is in full operation.

END OF SECTION 26 22 00
SECTION 26 24 13
SWITCHBOARDS

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this section.

1.02 REFERENCES

ANSI C57.13 - Instrument Transformers
NEMA AB 1 - Molded Case Circuit Breakers
NEMA KS 1 - Enclosed Switches
NEMA PB 2 - Dead Front Distribution Switchboards
NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Dead-front Switchboards Rated 600 Volts or Less.
UL-891 - Dead Front Switchboards

1.03 SUBMITTALS

A. Include plan and elevation layouts showing overall dimensions and compartment layout with available spaces; conduit entrance locations and requirements; nameplate legends; one-line diagrams; size and number of bus bars per phase, neutral, and ground; switchboard instrument details; instructions for handling and installation of switchboard; and electrical characteristics including voltage, frame size and trip ratings, withstand ratings, time-current curves, and interrupting ratings confirming a fully-rated system for all equipment and components.

1.04 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
   1. Bus tightening intervals and procedures
   2. Overcurrent protective device testing and maintenance procedures
   3. Coordination study and the overcurrent device set point recommendations
   4. Field report noting final adjustments to overcurrent protective device settings

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
B. Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.06 EXTRA MATERIALS

A. Submit one set of spare fuses of each size and type used in the equipment provided (If Required).

PART 2 - PRODUCTS

2.01 SWITCHBOARD CONSTRUCTION AND RATINGS (Install in Electrical Room #120)

A. Switchboard electrical rating and short circuit current rating shall be as shown on the Drawings.
B. The switchboard and overcurrent devices contained within shall be fully-rated.
C. Main Section Devices: Individually mounted.
D. Distribution Section Devices: Group-mounted and/or individually mounted, complete with bus in an integrated assembly. All breakers shall be bolted, quick-make, quick-break, trip indicating and common trip on all multi-pole breakers. No handle ties will be permitted.
E. Buses:
   1. The switchboard bussing (and all other current carrying parts such as fingers, neutral and ground buses) shall be plated copper. The bussing shall be of sufficient cross-sectional area to meet UL 891 temperature rise requirements.
   2. For 4-wire systems, the neutral bus shall be the equivalent ampacity as the phase bus bars.
   3. Provide a copper ground bus through the length of the switchboard sized per UL 891 and NFPA requirements.
   4. Ground bus shall be continuous throughout the length of the switchboard. Factory supplied bus jumpers shall be utilized for field connection of ground bus between shipping splits. Field fabricated jumpers are not permitted.
   5. Where spaces are indicated for future breakers, extend bus bars, drill and tap bus, and fully equip for the future breakers, including all connectors and mounting hardware.
   6. Line and load terminations shall be rated for the size, number of conductors and conductor material.
   7. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials used.
   8. Provide buss extensions as required to add a ‘FUTURE’ adjacent switchboard section.
F. Enclosure:
   1. Factory assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB2, and complete from incoming line terminals to loadside terminations.
   2. All closure plates shall be screw removable and small enough for easy handling by one person.
   3. Finish: Manufacturer's standard medium gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion resistant paint, or plate with cadmium or zinc.
   4. Enclosure shall be NEMA PB 2 Type 1 - General Purpose.
   5. Front accessible only.

2.02 MAIN CIRCUIT BREAKER

A. The main circuit breaker in 480V switchboard shall be an individually mounted and bussed molded case circuit breaker, 80% rated, with a full function electronic trip unit.

2.03 CIRCUIT BREAKER DISTRIBUTION SECTIONS

A. Distribution circuit breakers shall be group mounted in frame sizes 100 amp through 1200 amp. Frame sizes larger than 1200 amp shall be individually mounted.
B. The circuit breakers are to be totally front accessible and mounted in the switchboard to permit installation, maintenance and testing without reaching over line side bussing. The circuit breakers are to be removable by the disconnection of only the load side terminations and line and load side connections are to be individual to each circuit breaker. Common mounting brackets or electrical bus connectors are not acceptable.
C. Circuit breakers shall be provided with provisions for mounting handle padlock attachments.
D. Breaker feeder lugs shall be dual rated for use with either aluminum or copper conductors.
E. Each circuit breaker is to be furnished with an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate, as well as exercise the circuit breaker operating mechanisms.
F. A minimum of 25% future circuit breaker spaces shall be included. Spaces for future circuit breakers shall be “prepared” spaces. These spaces shall be provided with the necessary
mounting hardware and bus extensions so that when future breakers are added, only the breaker itself needs to be purchased by the installer.

G. Circuit breakers serving single motor loads shall be magnetic only, instantaneous trip. Overload protection shall be part of the motor combination controller.

H. Circuit Breakers:
   1. Electronic Trip Circuit Breakers: As scheduled on the drawings, electronic circuit breakers shall have, at a minimum, adjustments for long time, short time and instantaneous trip. Provide integral ground fault sensing with adjustable ground fault trip where indicated on the drawings.
   2. Molded Case Circuit Breakers: As scheduled on the drawings, integral thermal and instantaneous magnetic trip elements in each pole.

2.04 COORDINATION OF OVERCURRENT PROTECTIVE DEVICES (NOT REQUIRED)

2.05 INSTRUMENTS AND SENSORS (NOT REQUIRED)

   A. Provide an electronic meter (with meter test switch and instrument transformers) for Owner’s use in the switchboard. Meter and related equipment shall meet the requirements of specification section 26 27 13.

2.06 SURGE PROTECTIVE DEVICE (NOT REQUIRED)

PART 3 - EXECUTION

3.01 INSTALLATION

   A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.
   B. Install switchboard on a 3.5” high concrete equipment pad.
   C. Tighten accessible bus connections and mechanical fasteners after placing switchboard per manufacturer’s requirements.

3.02 FIELD QUALITY CONTROL

   A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
   B. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.
   C. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance is 2 megohms.
   D. Touch up scratched or marred surfaces to match original finish.

3.03 ADJUSTING

   A. Adjust all operating mechanisms for free mechanical movement.
   B. Adjust trip and time delay settings to values as recommended in coordination study or as instructed by the A/E. Include a copy of the coordination study and recommended circuit breaker set points in the O&M manual.

END OF SECTION 26 24 13
SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

Section 26 05 53 – Identification for Electrical Systems

1.02 SUBMITTALS

A. Include outline and support point dimensions, voltage, main bus amperage, circuit breaker arrangement and sizes, and interrupting ratings confirming a fully-rated system for all equipment and components.

1.03 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.04 SPARE PARTS

A. Keys: Furnish 2 keys for each panelboard to Owner.
B. One set of three spare fuses of each size and type utilized

PART 2 - PRODUCTS

2.01 POWER DISTRIBUTION PANELBOARDS (SQUARE ‘D’ ONLY)

A. Panelboards: Circuit breaker type.
B. The panelboard and overcurrent devices contained within shall be fully-rated.
C. Enclosure: NEMA Type 1 or as scheduled. Minimum cabinet size: 6.5 inches (165 mm) deep; 26 inches (660 mm) wide. Constructed of galvanized code gauge steel.
D. Cabinet front cover and cabinet shall be Type 3R, 4X, 304 stainless steel in wet and damp locations.
E. Power distribution panelboards installed in electrical rooms and mechanical rooms shall utilize a standard dead front cover. In all other areas provide cabinet front with hinged door, flush lock and hinged trim (door-in-door) to allow access to wiring gutters without removal of panel front. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
F. Provide metal directory holders with clear plastic covers.
G. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.
H. Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.
I. The circuit breakers are to be totally front accessible and mounted in the panelboard to permit installation, maintenance and testing without reaching over line side bussing. The circuit breakers are to be removable by the disconnection of only the load side terminations and line and load side connections are to be individual to each circuit breaker. Common mounting brackets or electrical bus connectors are not acceptable.
J. Circuit breakers shall be provided with provisions for mounting handle padlock attachments.
K. Breaker feeder lugs shall be dual rated for use with either aluminum or copper conductors.
L. Each circuit breaker is to be furnished with an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate, as well as exercise the circuit breaker operating mechanisms.

M. A minimum of 25% future circuit breaker spaces shall be included. Spaces for future circuit breakers shall be “prepared” spaces. These spaces shall be provided with the necessary mounting hardware and bus extensions so that when future breakers are added, only the breaker itself needs to be purchased by the installer.

N. Circuit breakers serving single motor loads shall be magnetic only, instantaneous trip. Overload protection shall be shall be part of the motor combination controller.

O. Circuit Breakers:
   1. Molded Case Circuit Breakers: As scheduled on the drawings, integral thermal and instantaneous magnetic trip elements in each pole.

P. Lugs:
   1. Provide main double lugs and/or feed-thru lugs.

2.02 BRANCH CIRCUIT PANELBOARDS (SQUARE ‘D’ ONLY)

A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
B. The panelboard and overcurrent devices contained within shall be fully-rated.
C. Enclosure: NEMA Type 1 or as scheduled. Minimum cabinet size: 5-3/4 inches (144 mm) deep; 20 inches (508 mm) wide with 5” minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO’s) to avoid concentric break out problem.
D. Cabinet front cover and cabinet shall be Type 3R, 4X, 304 stainless steel in wet and damp locations.
E. Provide cabinet front (flush or surface per plans) with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer’s standard gray enamel.
F. Provide metal directory holders with clear plastic covers.
G. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings.
H. Provide ground bars in all panelboards. Phase, neutral and ground bar terminations can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.
I. Incoming conductors shall terminate at lug landing pads rated for the panelboard. Provide double lugs and/or feed-thru lugs to allow installation of additional panelboards.
J. Provide mechanical screw (not compression) type lugs to accommodate the conductor shown on drawings.
K. Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.
L. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A ground fault interrupter circuit breakers where shown on Drawings. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
M. Do not use tandem circuit breakers.
N. Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.
O. All of the panelboards provided under this section shall be by the same manufacturer.
P. All sub-feed panelboards installed side by side shall utilize same enclosure height.

2.03 LOAD CENTERS

A. Load Centers with plug-on circuit breakers allowed ONLY in Residential Labs.
B. Equal manufacturers by General Electrical, Cutler Hammer, ETC. allowed only for Load Centers only.
PART 3 - EXECUTION

3.01 INSTALLATION

A. See section 26 05 29 for support requirements.
B. Install panelboards plumb with wall finishes.
C. Height: 6 feet (2 m) to top.
D. Install a crimp type stud termination to stranded conductor when terminating on circuit breakers without a captive assembly rated for terminating stranded conductors.
E. Provide filler plates for unused spaces in panelboards.
F. See section 26 05 53 for identification requirements. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

3.02 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.

END OF SECTION 26 24 16
SECTION 26 27 02
EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
   - Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   - Section 26 05 33 - Raceway and Boxes for Electrical Systems.
   - Section 26 05 53 - Identification for Electrical Systems
   - Section 26 27 26 - Wiring Devices
   - Section 26 27 28 - Disconnect Switches

1.02 SUBMITTALS

A. Product Data: Provide data for cord and wiring devices.

1.03 COORDINATION

A. Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

PART 2 - PRODUCTS

2.01 CORDS AND CAPS

A. Straight-blade Attachment Plug: NEMA WD 1.
B. Locking-blade Attachment Plug: NEMA WD 5.
C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
D. Cord Construction: Oil-resistant thermoset insulated multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that equipment is ready for electrical connection, wiring, and energy.

3.02 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.03 INSTALLATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
B. Provide a green equipment ground conductor for all installed equipment wiring.
C. Make conduit connections to equipment using flexible PVC-coated metal conduit.
D. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
E. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
F. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer’s instructions. Provide interconnecting wiring where indicated.
G. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

3.04 HVAC AND PLUMBING CONNECTIONS

A. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.
B. Contractor shall verify with mechanical contractor the electrical requirements including voltages, horsepower, disconnecting means, starters and variable frequency drives for motors and equipment prior to ordering circuit breakers, disconnects and starters.
C. VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power and output power, or control wiring in a common raceway.
D. Provide 120 volts to each temperature control panel. Coordinate quantity and exact locations with HVAC/DDC contractors. Connect to the nearest Emergency (Equipment Branch) panelboard.
E. Unless otherwise specified, all electrical motors and control devices such as aqua stats, float and pressure switches, fan powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed by the Contractor supplying the devices.
F. Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
G. Check for proper rotation of each motor.
H. All heating, air conditioning and refrigeration equipment installed on the exterior of the building or rooftop shall have a 120V, single phase 20 ampere rated outlet at an accessible location within 25 feet of the equipment.
I. Make connection to Elevator sump pump located in elevator pit, coordinate with plumbing contractor.

3.05 EQUIPMENT CONNECTION SCHEDULE

A. As indicated on the drawings.

3.06 ELEVATOR CONNECTIONS (Not Required for this Project)

A. Disconnect Switch (Power Module) - Fused Elevator Shunt Trip:
   1. Description: Provide shunt-trip fused disconnect switch with necessary relay(s), control transformer and other options, as required per specification Section 26 27 29.
   2. Connections:
      1. Provide all power wiring from source through disconnect to elevator controller to motor.
      2. Provide single means of disconnect; manual starter, enclosed circuit breaker or disconnect, labeled "elevator cab lights" located in equipment room Per NEC 620.22. The means of disconnect shall be capable of being locked in the open position. Extend 120-volt circuit from source through lockable switch to controller. Provide one lockable switch and 120-volt circuit per unit. The overcurrent device protecting the branch circuit shall be located in the elevator machine room.
      3. Provide 120V, 20 ampere separate branch circuit to serve machine room lighting and receptacle(s) per NEC 620.23. Provide light switch and duplex receptacle(s). A GFCI
receptacle shall be located adjacent to elevator motor. Required lighting shall not be connected to load side of GFCI.

4. Provide 120V, 20 ampere separate branch circuit to serve elevator pit lighting and receptacle(s) per NEC 620.24. Required lighting shall not be connected to load side of GFCI.

5. Provide 120V, 20 ampere separate branch circuit to serve elevator pit sump pump. Dedicated circuit shall not be GFCI protected.

6. Provide 120V, 20 ampere separate branch circuits for additional circuits supplying utilization equipment not identified in NEC 620.22, 620.23 and 620.4 but limited to loads per 620.1. Coordinate with elevator manufacturer’s requirements. Overcurrent devices protecting these additional loads shall be located in the elevator equipment room.

C. Lighting:

1. Provide minimum (4) 4’-LED Strip Type fixtures (2) elevator pit and (2) top of elevator shaft.

2. Provide switch adjacent to pit access ladder, 36” above door sill. Provide 3-way and 4-way switches, receptacle and lighting on every other floor above lowest level.

3. Provide 4’-LED strip type fixtures as required to maintain a minimum of 10 FC throughout the elevator pit.

4. Provide 4’-LED strip type fixtures as required to maintain a minimum of 19 FC throughout the elevator equipment room or required working clearance around equipment in roomless equipment locations (equipment integral with elevator car).

5. Provide elevator lobby LED lighting to provide minimum 10 FC at elevator door(s) with the door(s) closed.

D. Misc. connections:

1. Provide all wiring for and mount exterior alarm bell (If required). Feed from emergency source.

2. Provide smoke detector and heat detector in each elevator equipment room or space. Connect main alarm contacts to elevator recall alarm system and auxiliary contacts to the controller.

3. Provide smoke detector in each elevator lobby. Connect main alarm contacts to elevator recall alarm system and auxiliary contacts to elevator controller.

4. All traveling cables, control stations, control station wiring and final control connections at the controller shall be furnished and installed under Elevator Work.

5. Provide 3/4” conduit from controller to nearest available cable tray for two (2) four pair UTP Cat.6 cables to be provided and installed by WTC IT Department.

6. Coordinate entire installation with Elevator Contractor prior to rough-in.

7. Coordinate entire installation with Western Technical College IT department for communication and security requirements.

END OF SECTION 26 27 02
PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.02 SUBMITTALS

A. Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.
B. For occupancy sensor shop drawings, the manufacturer's actual layout of occupancy sensors and the wiring diagrams shall be provided.

1.03 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 -PRODUCTS

2.01 WALL SWITCHES

A. General: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade.
1. Handle: Gray color made of nylon or high impact resistant material.
B. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with separate green ground screw. Switches shall be Cooper Arrow-Hart1221*, Hubbell 1221*, Leviton 1221-S*, Pass & Seymour CS20AC1-*, or approved equal. (* indicates color selection).
C. Residential Grade wiring devices allowed ONLY in Residential Labs.

2.02 RECEPTACLES

A. General Requirements: NEMA Type 5-20R Gray color nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated.
B. Generally, all receptacles shall be duplex convenience type unless otherwise noted.
C. All receptacles designated as isolated ground shall have an isolated ground triangle imprint on the face of the receptacle.
D. All receptacles installed in bathrooms, kitchens, exterior and within 6 feet of the outside edge of sinks shall be GFCI type.
E. All receptacles installed in outdoor locations, garages, rooftops, and in other damp or wet locations shall be GFCI type with a weather-resistant (WR) rating.
F. Convenience and Straight-blade Receptacles: All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be Cooper Arrow-Hart 5362*, Hubbell5362*, Leviton5362-S*, Pass& SeymourPS5362-*, or approved equal. (* indicates color selection). Gray is the Campus standard color.
G. GFCI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A. GFCI receptacles shall be Cooper Arrow-Hart VGF20*, HubbellGF20*L, LevitonN7899-*, Pass & Seymour2095*, or approved equal.
H. **GFCI Receptacles with a weather-resistant (WR) rating:** Weather-Resistant duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class-A. WR GFCI receptacles shall be Cooper Arrow-Hart WRVGF20*, HubbellGFR5362^*TR, LevitonWR899*-*, Pass & Seymour2095TRWR*, or approved equal.

I. **Locking-Blade Receptacles:** As indicated on drawings.

J. **Specific-use Receptacle Configuration:** As indicated on drawings.

K. Provide Residential Grade, Tamper Resistant Devices in Residential Labs Only.

### 2.03 OCCUPANCY SENSORS

A. All occupancy sensors shall be hardwired type; battery type shall not be permitted.

B. **Wall Mounted (Wall Switch Type)**
   1. The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a standard single gang switch box.
   2. Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz
   3. Sensitivity shall be user adjustable or self-adjusting type.
   4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.
   5. The sensor shall have two switches where dual-level lighting is required. The off switch shall have manual override for positive off and automatic on.
   6. The test LED shall indicate motion.
   7. The area of coverage shall be approximately 180 degrees by 35-40 feet.
   8. The unit shall have a five-year warranty.
   9. Color shall be Gray.

C. **Ceiling Mounted**
   1. The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed to a box with ring and box support.
   2. Rated capacity shall be 20 amps at 120 or 277 volts, for fluorescent lamps. Line voltage sensors are acceptable, especially in exposed ceiling areas where all wiring shall be installed in conduit, including low voltage cabling if power packs are used. Provide power pack as required for low voltage sensors.
   3. Sensitivity shall be user adjustable or self-adjusting type.
   4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.
   5. The coverage area shall be 360 degrees by approximately 15 feet radius when mounted at 9 foot height. The sensor shall have provisions, such as masking, to block out problem areas.
   6. Test LED to indicate motion.
   7. The unit shall have a five year warranty.
   8. See drawings for actual type of sensor.

### 2.04 WALL DIMMERS (Line Voltage)

A. Wall Dimmers: linear slide semiconductor type, suitable for use with LED drivers (0-10 Volts), with positive ‘OFF’ as indicated on the Drawings.

### 2.05 LOW VOLTAGE LIGHTING CONTROL SYSTEM (Room Controllers)

A. Low voltage lighting control system shall be ‘Wattstopper’ as detailed on the drawings, no exceptions will be allowed, this is a WTC Campus-wide standard.
2.06 DEVICE PLATES AND BOX COVERS

A. **Standard Cover Plate**: Stainless Steel 302/304.

B. **Weatherproof Cover Plate**: Gasketed metal with hinged “in-use” device covers, powder coat painted. Non-metallic covers are not allowed. All receptacles installed in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug is inserted.

C. **Damp Location Cover Plate**: Gasketed metal with hinged device covers, powder coat painted. Non-metallic covers are not allowed. All receptacles installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure that is weatherproof when the receptacle is covered (attachment plug not inserted and receptacle covers closed).

D. **Surface Cover Plate**: Raised galvanized steel.

E. Residential grade, thermoplastic plates will be allowed in Residential Labs Only.

2.07 PHOTO CELLS (Not Required for this Project)

A. The controller shall be rated 2000 watts tungsten at 120, 240 or 277 volts. The cell shall be cadmium sulfide, 1" diameter.

B. The enclosure shall be die cast zinc, gasketed for maximum weather proofing.

C. The enclosure shall include the positioning lug on the top of the enclosure.

D. The unit shall have a delay of up to two minutes to prevent false switching. ON/Off adjustment shall be done by moving a light selector with a range from 2 to 50 foot-candles.

E. Mounting shall be for a 1/2" conduit nipple.

F. The unit shall have a 5-year warranty.

G. The contacts shall be SPST normally closed.

H. The operational temperature range shall be -40 to 140 degrees F (-40 to +60 degrees C).

PART 3 -EXECUTION

3.01 INSTALLATION

A. See plans for device mounting heights.

B. Install wall switches with OFF position down.

C. Wall dimmers: de-rate ganged dimmers as instructed by manufacturer; do not use common neutral.

D. Install convenience receptacles with grounding pole on bottom.

E. Install box for information outlet at the same height as adjacent convenience receptacles. Locate boxes for information outlet as close as practical to duplex power outlet, approximately 2-inches apart.

F. Install box for telephone jack for wall telephone at 46-inches to center above finished floor.

G. Install specific-use receptacles at heights shown on Contract Drawings.

H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

J. Install devices and wall plates flush and level.

K. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

L. Provide Circuit and Panel Identification on the FACE of wiring device cover plates.

M. Provide ‘GRAY’ wiring devices with Stainless Steel cover plates.

3.02 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch and sensor with circuit energized, and verify proper operation.

C. Verify that each receptacle device is energized.
D. Test each receptacle device for proper polarity.
E. Test each GFCI receptacle device for proper operation.

3.03 OCCUPANCY SENSORS

A. Provide a minimum of 4’ of coiled cable for ceiling-mounted sensors.
B. Occupancy sensors shall be installed at locations indicated on the manufacturer’s submittal layout drawings. Sensors shall be located to prevent false “ON” tripping of the lights.
C. Sensitivity Test: After the sensor has been energized for at least 15 minutes, walk to the middle of the room (if conference room) or sit at the normal desk position (if an office). Make no motion for 20 seconds. Move one arm up and down slowly. The test LED should blink.
D. Time Delay Test: Set the time delay for 10 minutes. Walk into the room to activate the sensor then leave room. Sensor must turn lights off at approximately 10 minutes. Walk into the room again to reactivate the lights. Lights should activate within 1 second.

3.04 ADJUSTING

A. Adjust devices and wall plates to be flush and level.
B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device, and on the back of the device cover.

END OF SECTION 26 27 25
SECTION 26 27 28
DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
   Section 26 05 26- Grounding and Bonding for Electrical Systems
   Section 26 05 29- Hangers and Supports for Electrical Systems
   Section 26 05 53- Identification for Electrical Systems
   Section 26 28 13- Fuses
   Section 26 27 02- Equipment Wiring Systems
   Section 26 29 00- Low voltage Controllers

1.02 SUBMITTALS

A. Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short circuit.

1.03 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.04 GENERAL

A. Provide disconnect switches for loads required by code. Review HVAC and Plumbing specifications to determine what equipment is furnished with disconnect switches. Install disconnect switches whether furnished under this contract or not. It is the Electrical Contractors responsibility to determine the need for a disconnect switch for each load. The contractors shall include in their bid the code required disconnect switches whether indicated on the drawings or not.

PART 2 - PRODUCTS

2.01 DISCONNECT SWITCHES

A. Fusible Switch Assemblies (use only when overcurrent protection is required): NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R, Class J or Class CC (motors) cartridge type fuses.

B. Non-fusible Switch Assemblies: NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosure:
   1. Indoor: NEMA 1 code gauge steel with rust inhibiting primer and baked enamel finish
   2. Outdoors: NEMA 3R code gauge zinc coated steel with baked enamel finish or NEMA 4 when indicated on drawings.
      b. Provide manufacturer’s equipment ground kit in all disconnect switches.
      c. In applications where the switch serves as the service entrance disconnect, provide service ground kit, label as service disconnect and provide UL listing for service disconnect.
2.02 **FUSES**

A. Fuses 600 Amperes and Less: Dual element, time delay, 250-volt, UL Class RK 1, LPJ Interrupting Rating: 200,000 rms amperes.
B. Fuses 601 Amperes and Larger: Low Peak, time delay, 600-volt, UL Class L. Interrupting Rating: 200,000 rms amperes.
C. Fuses 30 Amperes and less: Time-Delay, 600-volt, UL Class CC, UL Class RK. Interrupting rating: 200,000 rms amperes.
D. Provide three (3) spares of each size and type fuse.

**PART 3 - EXECUTION**

3.01 **INSTALLATION**

A. Install disconnect switches where indicated on Drawings or required by NEC.
B. Provide identification as specified in Section 26 0553.
C. Provide label on inside of disconnect cover identifying the type and size of fuse to be utilized.

**END OF SECTION 26 27 28**
SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.02 SUBMITTALS

A. Provide device dimensions, nameplate nomenclature, and electrical ratings.
B. Submit manufacturer's product data sheets with installation instructions.

1.03 REGULATORY REQUIREMENTS

A. Listed by Underwriter's Laboratories, Inc., and suitable for specific application.

1.04 EXTRA MATERIALS

A. Provide three (3) spares of each size and type fuse.

PART 2 - PRODUCTS

2.01 FUSES

A. Fuses 600 Amperes and Less: Dual element, time delay, 250-volt, UL Class RK 1, LPJ Interrupting Rating: 200,000 rms amperes.
B. Fuses 601 Amperes and Larger: Low Peak, time delay, 600-volt, UL Class L. Interrupting Rating: 200,000 rms amperes.
C. Fuses 30 Amperes and less: Time-Delay, 600-volt, UL Class CC, UL Class RK 1. Interrupting rating: 200,000 rms amperes.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fuses shall not be installed until equipment is ready to be energized.

END OF SECTION 26 28 13
SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 – GENERAL (PROVIDE ONLY IF REQUIRED)

1.01 RELATED WORK
A. Applicable provisions of Division 1 govern work under this Section.

1.02 REFERENCES
A. NEMA AB 1 - Molded Case Circuit Breakers.

1.03 SUBMITTALS
A. Include circuit breaker ratings, withstand ratings, frame size, time-current and let-through current curves, outline dimensions, and terminal lug sizes.

1.04 OPERATION AND MAINTENANCE DATA
A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.05 REGULATORY REQUIREMENTS
A. Circuit breakers listed by Underwriter's Laboratories, Inc., and suitable for specific application.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

PART 2 - PRODUCTS

2.01 CIRCUIT BREAKERS
A. Molded Case Circuit Breakers: Inverse time with integral thermal and instantaneous magnetic trip elements in each pole.

2.02 RATINGS:
A. Ratings as shown on the Drawings.

2.03 ENCLOSURE
A. Enclosure: NEMA AB 1; Type 1, 3R
B. Fabricate enclosure from steel.
C. Finish using manufacturer's standard gray enamel finish.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Install enclosed circuit breakers where shown on Drawings, in accordance with manufacturer's instructions.
3.02 FIELD QUALITY CONTROL
   A. Inspect visually and perform several mechanical ON-OFF operations on each circuit breaker.

END OF SECTION 26 28 16
SECTION 26 29 00
LOW VOLTAGE CONTROLLERS

PART 1 - GENERAL

1.01 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this Section.
   Section 26 05 29 - Hangers and Supports for Electrical Systems
   Section 26 05 53 - Identification for Electrical Systems

1.02 COORDINATION WITH OTHER TRADES

A. Motors: In general, all electric motors required for this installation will be supplied with
   equipment, apparatus and/or appliances covered under other sections of the specifications.
B. For the sake of consistency and conformity of manufacturer, design and construction, all motors
   shall conform to the following description unless otherwise noted or required.
   1. Motors 1/3 HP and smaller shall be wound for operation on single phase, 60 Hz. service
      unless otherwise noted.
   2. Motors 1/2 HP and above shall be wound for operation on 3 phase, 60 Hz service unless
      otherwise noted.
   3. Refer to drawings in each case in order to verify voltage characteristics required.
C. Equipment:
   1. All building utility motors such as fans, pumps, overhead doors, etc., together with certain
      "controlling equipment" for same, except motor starters and related apparatus, will be
      furnished under other sections of the specifications and delivered to the building site
      unless specifically noted otherwise. The above mentioned "controlling equipment"
      pertains to electrical thermostats, electro-pneumatic and pneumatic-electric and detection
      devices, or any other device not purely electrically operating in nature.
   2. The starters for these motors shall be furnished and installed by the Electrical Trade
      unless noted otherwise (See Motor Schedule on Drawings).
   3. The Electrical Trade shall set and connect all specified starting equipment, install all
      power conduits and wiring and shall furnish and make all connections from starting
      equipment to motors as required to leave the apparatus in running condition.
   4. All VFD Motor Starters will be furnished and installed by Electrical Contractor.
D. Wiring Connections:
   1. Furnish branch circuits for all motors to the starting equipment and then to the motors,
      complete with all control wiring for automatic and remote control where required or noted.
      Conduits to motors shall terminate in the conduit fittings on the motors, the final
      connection being made with flexible, PVC-coated metal conduit.
   2. Provide all necessary labor and material to completely connect all electrical motors and
      controls (where required) in connection with the building utility equipment, including fans,
      pumps, overhead door operators, etc.
   3. All conduits and wiring required for control work from the holding coil circuit of the starter,
      including the furnishing and installation of control devices such as auxiliary contacts,
      control relays, time delay relays, pilot lights, selector switches, alternators, etc., shall be
      provided and installed by other trades unless otherwise indicated.
E. Power Branch Circuits:
   1. Wire sizes for branch circuits not specifically called for on drawings or in specifications
      shall be based on 125 percent of the full load current of the motor unless the voltage drop
      of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in
      which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be
      used for motors in such calculations.
1.03 REFERENCES
ANSI/NEMA ICS 6 Industrial Control and Systems: Enclosures.
ANSI/UL 248-8 Low-Voltage Fuses - Part 8: Class J Fuses.
NEMA AB 1 Molded-case Circuit Breakers, Molded Case Switches, and Circuit-breaker Enclosures.
NEMA ICS 2 Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.
NEMA ICS 18 Motor Control Centers.
NEMA KS Enclosed and Miscellaneous Distribution Equipment Switches.
NEMA PB 1 Panelboards.
NEMA PB 1.1 General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

1.04 SUBMITTALS
A. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

1.05 OPERATION AND MAINTENANCE DATA
A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.07 SPARE PARTS
A. Keys: Furnish two (2) each to Owner.

PART 2 - PRODUCTS

2.01 MANUAL MOTOR STARTERS
B. Three-phase Manual Motor Starter: NEMA ICS 2; size as shown on Drawings. AC general-purpose Class A manually operated full-voltage controller for induction motors rated in horsepower, with overload protection, red pilot light and toggle operator.
C. Enclosure: NEMA Type 1, or as indicated on the drawings.
D. Provide manufacturer’s equipment grounding kit in all starter enclosures.

2.02 MAGNETIC MOTOR STARTERS
A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower; size 0 minimum.
B. Full Voltage Starting: Non-reversing type.
C. Size: NEMA ICS 2; size as shown on Drawings, size 0 minimum.
D. Coil Operating Voltage: 120 volts, 60 Hz.
E. Overload Protection: The overload shall be solid-state, self-powered, provide phase loss and phase unbalance protection, have a permanent tamper guard, and be ambient insensitive. The overload shall have a mechanical test function.
F. Enclosure: NEMA Type 1, or as indicated on the drawings.
G. Provide manufacturer’s equipment ground kit in all starter enclosures.
H. Auxiliary Contacts: NEMA ICS 2, two (2) field convertible contacts in addition to seal-in contact.
I. Selector Switches: NEMA ICS 2, HAND-OFF-AUTO in front cover.
J. Indicating Lights: NEMA ICS 2; red “RUN” LED Push-to-test type in front cover.
K. Control Power Transformers: Each magnetic starter shall have a fused primary and a fused 120V secondary control transformer, sized for the load, 50 VA minimum. Additionally, the X2 terminal of the control transformer shall be grounded.
L. Combination Motor Starters: Combine motor starters with fusible switch disconnect in common enclosure.

2.03 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

A. Fusible Switch Assemblies: NEMA KS; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class J fuses.

2.04 FUSES

A. Fuses 600 Amperes and Less: Dual element, time delay, 250-volt, UL Class J. Interrupting Rating: 200,000 rms amperes.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install motor control equipment in accordance with manufacturer’s instructions.
B. Set overload protection in motor starters to match installed motor characteristics.
C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
D. Six (6) VFD Drives shall be furnished and installed by Electrical Contractor. Install in Commercial Labs as noted on drawings.

END OF SECTION 26 29 00
SECTION 26 36 00
TRANSFER SWITCHES

PART 1 - GENERAL

1.01 RELATED WORK
A. Applicable provisions of Division 1 govern work under this section.

1.02 REFERENCE STANDARDS
A. The following references shall apply to the installation of equipment under this section.

UL 1008- Standard for Transfer Switch Equipment
Wisconsin Administrative Code SPS 316 Edition
NFPA 110- Emergency and Standby Power Systems

1.03 QUALITY ASSURANCE
A. Manufacturer: Company specializing in automatic transfer equipment with five years documented experience.

1.04 SUBMITTALS
A. Submit product data showing overall dimensions, electrical connections, electrical ratings, withstand current rating (WCR’s), all specified accessories, interlock methods, and environmental requirements.
B. Submit manufacturer's installation instructions.

1.05 OPERATION AND MAINTENANCE DATA
A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
B. In addition to the general content specified under GENERAL REQUIREMENTS, include instructions for operating equipment under test and emergency conditions.

PART 2 - PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCHES
A. Open Transition Type:
   1. Furnish and install Open Transition Automatic Transfer Switch (ATS) with number of poles, ampere rating, voltage, and 28KAIC withstand ratings as indicated on drawings. Each automatic transfer switch shall consist of a double throw power transfer switch mechanism and microprocessor controller to provide automatic operation.
B. Description: NEMA ICS 2; automatic transfer switch.
C. Configuration: The transfer switch shall be electrically operated and mechanically held. The electrical operation shall be by a solenoid mechanism operating from the same source to which the load is being transferred.
D. The switch shall be rated for continuous duty and be mechanically interlocked to be in either the normal or the emergency position.
E. The switch shall be controlled by a single built-in microprocessor with serial communications module. Controller shall be connected to the transfer switch by plug type with associated
interconnected wiring harness. Relays shall be industrial grade with dust covers, mounted separate from the transfer switch.

F. All customer wiring connections shall be to a common terminal block for ease of field wiring.

G. The switch shall be designed and built so that it can be manually operated under no-load conditions from behind a barrier partition or with the door closed. The enclosure shall allow for inspection of the internal operation of the switch through a full sequence of the transfer cycle with the door open and the switch de-energized.

H. In applications where the switch serves as the service entrance disconnect, the switch shall be rated as suitable for use as a service disconnecting means.

2.02 RATINGS

A. Ratings: Provide One (1) 30 amp., 120/208 VAC, 3-pole with Neutral for simulated Life Safety Emergency Branch, locate in ATS closet in Electrical Room #120. Provide One (1) 60 amp. 120/208 VAC, 3-Pole with Neutral for simulated Emergency Equipment Branch, locate in Electrical Room #120.

B. The minimum withstand and closing rating (WCR) shall be the available fault current at the installed location of the transfer switch. Unit shall be rated to close in and withstand the available RMS symmetrical short circuit current at the terminals with the type and rating of overcurrent protection shown on plans.

C. WCR ratings shall not be based on specific circuit breakers or fuses. Switches shall be tested and listed for use with any manufacturer’s circuit breaker or fuse within its rating or fuse class. Switches shall be tested per UL1008.

2.03 SEQUENCE OF OPERATION

A. Controller keypad and display.

1. Provide minimum 4 line, multi character LCD display and keypad controller for viewing all available data and settings operational parameters. Provide serial communications input port.

B. The following parameters shall be adjustable via DIP switches: Nominal line voltage and frequency, single or three phase sensing.

C. Voltage, frequency and phase rotation sensing.

D. Continuously monitor voltage and frequency on both normal and alternate sources with pickup, drop out and trip setting capabilities.

E. Voltage and frequency settings shall be field adjustable in 1% increments via keypad or serial communications port.

F. The controller shall sense the phase rotation of both sources.

G. Source information shall be indicated on data screen for normal and alternate sources to provide readout of voltage on all phases, frequency and phase rotation.

H. Time delay settings shall be adjustable utilizing LCD display and keypad or serial communications port.

2.04 TIME DELAYS

A. Adjustable time delay of 0 to 6 seconds to override momentary normal source outages and delay all engine start signals.

B. Adjustable time delay of 0 to 6 seconds to override momentary normal source outages and delay all transfer signals.

C. Time delay on transfer to alternate source, adjustable from 0 to 60 minutes, upon source monitor and permission by alternate source monitor.

D. Time Delay before transfer to Normal Source: Upon permission by normal source monitor. An additional time delay module shall provide function for test mode. 0 to 30 minutes, adjustable.

E. Time Delay Before Engine Shut Down: 0 to 30 minutes, adjustable, unloaded operation.

F. Operating transfer time of the switch in either direction shall not be greater than 1/6 of a second.
G. Time Delay activated output signal shall also be provided to control external relays for selective load control. Delays shall be minimum of 0 to 5 minutes in the following modes: prior to transfer, prior to and after transfer, normal to alternate source only, alternate to normal source only, normal to alternate to normal.

2.05 ACCESSORIES

A. Engine Exerciser: Digital control, start engine every 7 to 31 days adjustable; run for 0 to 120 minutes adjustable, before shutting down. Bypass exerciser control if normal source fails during exercising period.

B. Manual Operator: Provide manual operator to allow switch to be operated under no-load conditions from behind a barrier partition or with the door closed.

C. Provide three position momentary test switch for the test/automatic/reset. The test position will simulate a normal source failure. The reset switch shall bypass the time delays on either transfer to alternate source or retransfer to normal.

D. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

E. Indicating Lights: LED type. Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, and SWITCH POSITION.

F. Transfer Switch Auxiliary Contacts: Minimum 2 normally open; 2 normally closed, rated 10 amps. Minimum one shall be closed when ATS is connected to the normal source and one closed when ATS is connected to the alternate source.

G. A factory installed equipment ground bar shall be provided in each switch enclosure.

H. Three-pole transfer switches shall contain a factory installed fully rated solid neutral lug assembly.

2.06 ELEVATOR CONTROL INTERFACE ACCESSORIES (NOT REQUIRED)

A. Transfer switches serving elevators shall be provided with auxiliary contacts designed to provide emergency system status to the elevator controllers. These contacts are in addition to the contacts required elsewhere in this specification. Required auxiliary contacts are as follows:
   1. Emergency power signal contact. This shall be a form C contact that will change state and maintain its state as long as the transfer switch has transferred to the emergency power source.
   2. Pre-transfer warning signal contact. This contact shall be activated prior to the operation of the transfer switch, in either direction. These contacts shall change state prior to the transfer of power for a period of time as determined by the elevator installer, typically in the range of 10 to 20 seconds. These contacts shall reset to their normal state after the transfer has taken place. The pre-transfer warning signal shall not delay transfer for a time greater than allowed by the applicable codes.

2.07 MANUFACTURER

A. Provide ASCO Series 300 or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions. Please note no emergency generator included with this project. Transfer Switch installed for simulated instructional purposes only.

B. Starting contacts for all transfer switches shall be wired to a ‘FUTURE’ generator starting circuit so that any transfer switch that senses a loss of normal power will start the generator. This control wiring is not shown on the plans but is required to be provided by the electrical contractor.

C. Control wiring for Emergency Systems (NEC 700) shall be kept entirely independent of all other wiring and shall be installed per NEC 700.9 (D)(1).
D. Wiring between the elevator control contacts and the elevator controllers is not shown on the plans but is required to be provided by the electrical contractor. Terminations at the elevator controller shall be by the elevator installer.

3.02 FIELD ADJUSTMENTS

A. The contractor shall field adjust all timing and voltage settings of the transfer switch as necessary for proper operation of the switch, related loads and sources.

3.03 TESTING

A. Maintenance and operational testing shall be per NFPA 110-8.3.
B. Operational inspection and testing shall be per NFPA 110-8.4.

END OF SECTION 26 36 00
PART 1 - GENERAL

1.01 RELATED WORK
A. Applicable provisions of Division 1 govern work under this Section.

1.02 SUBMITTALS
A. Include outline drawings, LED drivers, support points, weights, accessory information and performance data for each luminaire type.
B. For each luminaire type, submit luminaire information and submit catalog cuts with highlighted catalog numbers and required accessories.

1.03 OPERATION AND MAINTENANCE DATA
A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.01 INTERIOR LUMINAIRES AND ACCESSORIES
A. See the Lighting Fixture Schedule on the drawings, for type of fixtures and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Fixtures manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated fixtures, and meet the intent of the design.
B. LED Lighting Fixtures (ONLY) will be installed for this project.
C. Provide LED lighting fixtures approved by Focus–On–Energy for this project.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer’s instructions.
B. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Heavy duty jack chain supports may be used where indicated on the fixture schedule. Provide pendant or chain length required to suspend luminaire at indicated height.
C. Support luminaires larger than 2 x 4 foot (600 x 1 200 mm) size independent of ceiling framing.
D. Locate ceiling luminaires as indicated on reflected ceiling plan.
E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
F. The Contractor shall install fixture supports as required. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor’s responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.
G. Install recessed luminaires to permit removal from below.
H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
I. Install code required hardware to secure recessed grid-supported luminaires in place.
J. Install wall mounted luminaires and exit signs at height as scheduled.
K. Install accessories furnished with each luminaire.
L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
M. Bond fixtures and metal accessories to branch circuit equipment grounding conductor.
N. Install specified lamps in each luminaire and exit sign.
O. All LED/Drivers shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the project. Lamps shall be taken directly from the cartons and installed in the fixture with special care so that they do not become dusty and are not soiled in the operation.
P. All new LED Fixtures shall be operational at the Substantial Completion of the project.

3.02 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
B. Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.
C. Touch up luminaire finish at completion of work.

3.03 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.04 ALL FIXTURE CONNECTIONS

A. Direct box or conduit connections for surface and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Flexible metal conduit shall be minimum 3/8" (10 mm) minimum diameter and six foot (1.8 M) maximum length. Conduit length shall allow movement of the fixture for maintenance purposes.
B. The flexible connectors shall be all steel, galvanized, clamp type with locknut or snap-in connector including those used on the master-slave unit.

END OF SECTION 26 5113
PART 1  GENERAL

1.01  SCOPE

A. This section describes the products and execution requirements relating to furnishing and installation of Telecommunications Cabling and Termination Components and related sub-systems as part of a Structured Cabling System at the new building addition.

1.02  RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

- Section 26 05 00 – Common Work Results for Electrical
- Section 26 05 33 – Raceway and boxes for Electrical Systems
- Section 26 27 26 – Wiring Devices
- Section 26 05 26 – Grounding and Bonding for Electrical Systems
- Section 26 27 02 – Equipment Wiring
- Section 26 05 53 – Identification for Electrical Systems

1.03  REGULATORY REFERENCES

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the Wisconsin Electrical Code and present manufacturing standards.

B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. Other applicable standards are as follows:
   2. NFPA 70-2002 - National Electrical Code
   3. DILHR Chapter 16 - Wisconsin Electrical Code
   4. TIA/EIA Standards 526-14A (OFSPT-14A), 526-7 (OFSPT-7), 568B.1 (Category 6e), 568B.2 (Category 6), 568B.3, 569A, 606A, and 607 (with exception)
   6. ICEA publication S-80-576-2002

1.04  DESIGN INTENT

A. The Horizontal (Station) Cabling System is based on the installation of 4-Pair Unshielded Twisted Pair (UTP) DATA Category 6 and 4-Pair UTP IP VOICE Category 6 Copper Cables.

B. Station cables shall be installed in conduit and/or free air. Outlets shall be mounted flush on a wall-mounted box, and/or on Surface Raceway. Information Outlet locations are to be identified on Project Drawings.

C. At the Data Hub Rooms, Data and IP Phone cable terminations shall be mounted on freestanding equipment racks; (as indicated on the drawings) termination hardware related to Data and Voice Cabling shall be rack mounted.

D. All cables and related termination, support and grounding hardware, bonding, shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in the following section[s].

E. The Contractor shall provide all labor and materials necessary to construct the system as described herein. This includes but is not limited to - furnishing and installing cable, cable
supports, racking and termination components, termination, testing, labeling and documentation.

1.05 WORK SEQUENCE

A. During the construction period, coordinate telecommunications schedule and operations with the Architect, Engineer and WESTERN TECHNICAL COLLEGE IT department.

1.06 SUBMITTALS

A. Under the provisions of Section 26 05 00 and Division 1, prior to the start of work the Contractor shall submit:
B. Electronic sets of Manufacturer’s Data covering all products proposed indicating construction, materials, ratings and all other parameters identified in Part 2 (Products) below.
C. Manufacturer’s installation instructions.
D. Submittals should be electronically grouped to include complete documentation of related systems, products and accessories in a single submittal. Where applicable, dimensions should be marked in units to match those specified.
E. Submittals shall be original catalog sheets, photocopies, or electronic format (ADOBE Portable Document format “.pdf”) thereof. Facsimile (fax) sheets shall not be accepted.
F. Two sets of submittals. The Engineer shall review the Submittals and annotate them indicating approvals and shall return to the contractor.
G. Work shall not proceed without the Engineer’s approval of the submitted items.
H. If materials are furnished as specified no further qualifications is necessary, except for items requiring shop drawings. However, if the Contractor wishes to substitute another manufacturer and/or catalog number, the following information in triplicate shall be submitted to the Engineer:
   1. A complete description of the material which the contractor proposes to substitute (shop drawings, illustrations, catalog data, performance characteristics, etc.) and the reason for the substitution identifying any benefit to the Owner.
I. The Contractor shall receive approval from the Engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the Engineer.

1.07 PROJECT RECORD DOCUMENTS

A. Submit and record documents under provisions of 26 0500.
B. Accurately record exact sizes, locations and quantities of cables.

1.08 QUALITY ASSURANCE

A. The manufacturer shall be a company specializing in communication cable and/or accessories with a minimum of five years documented experience in producing cable and/or accessories similar to those specified below.
B. The contractor shall have been in this line of business for a minimum of five (5) years.
C. The installing contractor shall have at a minimum one (1) Certified Installer trained to the latest industry standards to ensure the most reliable installation available. The Certified Installer shall have been trained by a company(s) that offers a minimum fifteen (15) year system warranty.

1.09 DELIVERY, STORAGE AND HANDLING

A. Cable shall be stored according to manufacturer’s recommendations as minimum. In addition, cable must be stored in a location protected from vandalism and weather.
1.10 DRAWINGS

A. It shall be understood that the electrical and telecommunication details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the Contractor in bidding the job. The Contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.

C. Prior to submitting the bid, the Contractor shall call the attention of the Engineer to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted, within ten (10) days prior to the Bid Due Date.

PART 2 PRODUCTS

2.01 INFORMATION OUTLET

A. Station cables shall each be terminated at their designated workstation location in the connector types described in the sub-sections below. Included are modular jacks (IP Voice & Data) assemblies. These connector assemblies shall snap into a mounting frame. All ports shall be installed such that the opening faces the floor. The combined assembly is referred to as the Standard Information Outlet (SIO).

1. SIO mounting configurations shall be as follows:
   a. Flush where existing boxes are in place
   b. Surface mounted on Systems Furniture (base panel) - Systems Furniture Type shall be defined prior to construction. Existing concrete block and brick walls and similar wall construction types.
   c. All data/IP voice jacks shall be flush mounted where possible.

2. The Telecommunications Outlet Frame shall accommodate:
   a. a minimum of One (1), when installed on a wall-mounted assembly.
   b. a minimum of One (1), when installed on modular furniture (where applicable)
   c. the outlet frame shall incorporate a mechanism for adjusting the surface plate to a plumb position.

B. Multiple Jacks - identified in close proximity on the drawings (and not separated by a physical barrier) - may be combined in a single assembly. The contractor shall be responsible for determining the optimum compliant configuration based on the products proposed and documenting these in the as-built records.

C. The same orientation and positioning of Jacks and Connectors shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each SIO type for review by the Engineer.

D. Wall Mount Outlet Faceplates shall incorporate identifying labels.

E. Where stand-alone "Data" or "IP Voice" only Jacks are identified, the SIO Frame shall be configured as to allow for the addition of one (1) additional jack (Voice or Data) to be installed to supplement each such jack as defined by this project. The installation of these supplemental Jacks IS NOT part of this project.

F. Any unused jack positions shall be fitted with a removable blank inserted into the opening.

G. The faceplate of the SIO shall be constructed of Stainless Steel.

H. Wall-mounted "Voice Only" outlets shall be installed where identified on the Floorplan Drawings to accommodate wall-mounted telephone sets. The Wall Plate shall be of Stainless-Steel construction, accommodate one (1) voice jack as defined below, mount on a standard single gang outlet box or bracket and include mating lugs for wall phone mounting.

I. All Standard Information Outlets and the associated Jacks shall be of the same manufacturer throughout the project. An allowable exception, however, is the Wall-mounted "Voice Only" Outlet described above. Manufacturer must be approved by WTC IT Department (No Exceptions).
2.02 DATA AND IP VOICE JACKS (Category 6 and Category 6A)

A. Data and IP Voice jacks shall be an 8-pin Modular Jack.
B. The interface between the jack and the station cable shall be a 110-Style block or insulation displacement type contact. Termination components shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.
C. Data Jacks shall be pinned TIA-568B with the pairs as follows:
   1. TIA-568B: Pair 1 - Pins 5 & 4
   2. Pair 2 - Pins 1 & 2
   3. Pair 3 - Pins 3 & 6
   4. Pair 4 - Pins 7 & 8
D. IP Voice Jacks shall be pinned TIA-568B with the pairs as follows:
   1. TIA-568B: Pair 1 - Pins 5 & 4
   2. Pair 2 - Pins 1 & 2
   3. Pair 3 - Pins 3 & 6
   4. Pair 4 - Pins 7 & 8
E. Transmission characteristics of the Data and Voice Jack shall be as required to meet the TIA/EIA Category 6 and Category 6A performance criteria. Refer to the Execution Section which details the required performance criteria of the completed Link of which the Jacks are a part.
F. The Jack shall be UL verified and listed.
G. Jack contacts shall have a minimum of 50 micro-inches of gold plating.
H. The color of the Data Jacks shall be as noted on the drawings or as determined by WTC IT Department, the school has strict color standards which must be followed.
I. All face plates shall be Stainless Steel.

2.03 WALL-MOUNT IP VOICE-ONLY OUTLETS

A. Wall mounted "voice only" outlets shall be installed where identified ("W") on the Project Drawing(s) to accommodate wall-mounted telephone sets. The Wall Plate shall be of Stainless-Steel construction, accommodate one (1) voice jack as previously defined, mounted on a standard single gang outlet box or bracket and include mating lugs for wall phone mounting.

2.04 DATA ANGLED PATCH PANEL (Category 6 and Category 6A)

A. Data cabling shall be terminated at the equipment rack located in Electrical Room #109 on patch panels incorporating Modular Jacks meeting the specifications for the Telecommunications Outlet detailed in the Section above.
B. At the Equipment Rack in Electrical Room, these panels shall be rack mounted-Angled.
C. The Data Patch Panel shall consist of a Modular to 110-type connector system. Modular jacks shall meet the specifications detailed above (NON-KEYED 8-pin).
D. The largest single patch panel configuration shall not exceed 48 ports. Panels which are modular shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12-jacks. High density patch panel configurations must incorporate horizontal cable management systems sized to accommodate the quantity of patch panel jacks being installed.
E. The Patch Panel blocks shall have the ability to seat and cut 8 conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Data blocks shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.
F. The Data Patch Panel as a system (including jack, cable interface and intermediate components) must maintain Category 6 and Category 6A performance per the referenced TIA/EIA documents. All pair combinations must be considered, with the worst-case measurement being the basis for compliance.
G. Panels shall incorporate cable support and/or strain relief mechanisms to secure the
horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

H. The Patch Panel shall have color coded designation strips to identify cable count.

I. Transmission performance shall be maintained by the Data Patch Panel as a system (including jack, cable interface and intermediate components).

2.05  EQUIPMENT RACKS

A. Free Standing Equipment Rack (4-Post Only):
   1. At Electrical Room #109, One (1) Equipment Rack shall be furnished and installed by the electrical contractor to house Cable Termination components (e.g. Copper Data/voice) and Network Electronics (by WTC IT Department).
   2. The rack shall conform to the following requirements:
      a. Rack shall be 4 post-type, 84” in height and shall be self-supporting.
      b. Channel uprights shall be spaced to accommodate Industry standard 19” mounting.
      c. Rack must be constructed of aluminum and have either a coating or painted surface.
      d. Rack shall be double-side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on rack front shall be per EIA/TIA specifications (5/8”-5/8”-1/2”). Hole pattern on the rear shall be at 3” intervals to accept cable brackets.
      e. Rack should be supplied with a supply of spare screws (minimum of 24).
      f. Base footprint should be no smaller than 15”x20”.
      g. Rack should be supplied with a ground bar and #4 AWG Ground lug (minimum).

B. Wall-mounted Equipment Rack(s):
   1. Provide Two (2) 18U wall-mounted equipment rack(s) as noted and detailed on the drawings for this project. Install One (1) wall-mounted equipment rack in Flex Lab #107 and provide One (1) wall-mounted rack in Electrical Room #120.
   2. Provide locking cover.

C. Jumper Management
   1. Rack shall be equipped with Vertical and Horizontal Jumper Management Hardware in the form of rings and guides, as to allow an orderly routing of twisted pair, optical fiber and coaxial jumpers from the patch panels to the customer provided network equipment. Jumper management hardware shall be as follows:
      a. Horizontal Jumper Management
         i. Panels shall be plastic (3.5” panel), have a minimum of five (5) Jumper distribution rings (1.75” x 3.75” minimum dimension) and incorporate jumper routing clips (plastic) for individual jumpers.
         ii. At minimum, horizontal cable management hardware shall be positioned above and below (a) each grouping of two rows of Data Patch Panels.
      b. Vertical jumper management
         i. Shall provide for cable routing on front and rear of each rack and be 3½” square (minimum). Vertical Jumper Management hardware shall mount on spacers attached to the rack uprights and not on the upright itself. Where multiple racks are to be installed, this hardware shall be mounted between the uprights of adjacent racks. Rack uprights and the spacers shall be secured together per manufacturer recommendations.
         ii. Each rack shall be supplied with a minimum of twelve (12) releasable (e.g. "hook & loop") cable support ties.

D. NOTE: Where Cable Termination Hardware is wall mounted, the contractor shall be responsible for establishing a cable pathway for jumpers routed from the Equipment Rack(s) to the wall. This shall be in the form of slotted ducts, troughs, "D" rings or other means. The proposed method shall be included in the submittals required by this document and shall be approved by the Engineer prior to installation.
2.06 Horizontal CAT 6 and CAT 6A Cable (Plenum rated)

A. Description: 24 AWG, 4-pair UTP, covered with a thermoplastic jacket:
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with ANSI/TIA/EIA-568-B.2, for performance specifications.
   3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
      b. CMR
   5. Category 6, 550MHz (minimum), UTP PVC Cable.
   6. Polyethylene Insulation.
   7. Unshielded twisted pair.
   8. Blue jacket color, or as required by WTC IT Department Color Requirements.
   9. Manufacturer: Hubbell, model #C6RPB or approved equal.


2.07 MISCELLANEOUS MATERIALS

A. IP Voice and DATA Station Patch Cords
   1. The contractor is to furnish voice station patch cords which are six inches or less in length and consist of an 8P8C plug (pinned 568B) and connected to an 8P8C jack with Category 6 cable.
   2. The Contractor is to furnish **ALL** data station CAT6 patch cords, length as required.
   3. Provide double the amount of patch cords compared to data and IP jacks. Provide **ALL** patch cords for this project, the electrical contractor is responsible to determine total quantity for project. No additional compensation will be allowed for non-sufficient patch cords, a complete workable system shall be provided.

B. Power Strip / Surge Suppressor
   1. At each Telecommunications Equipment Rack, one (1) Power Strip / Surge Suppressor shall be furnished and installed by the contractor to provide for powering of the network electronics (by others).
   2. Power Strip / Surge Suppressor shall:
      a. be rack mountable (19-inch rack)
      b. Shall be compliant with UL-1449, UL 1283 and UL-497A.
      c. Provide Transient suppression to 13,000-A. Protection shall be in all 3 modes (hot-neutral, hot-ground & neutral-ground).
      d. Shall meet or exceed IEEE 587 Category A & B specification.
      e. Provide High Frequency Noise Suppression as follows:
         f. >20-Db @ 50-kHz
         g. >40-Db @ 150-kHz
         h. >80-Db @ 1-MHz
         i. >30-Db @ 6- to 1000-MHz
         j. Provide a minimum of 320 Joules of AC Energy Absorption.
         k. Shall be equipped with a 12-foot power cord
         l. Provide a minimum of six (6) outlets
   3. Uninterruptible Power Supply (UPS)
      a. 2 U design for Rack or Tower mount.
      b. Hot swappable batteries.
      c. Rating: 1500 VA.
      d. Power Factor: .99
      e. Operating Temperature: 32 to 104 degrees F.
      f. Input Voltage: 120VAC
      g. Input Frequency: 45-66 Hz.
      h. Nominal Input Current Charging: 13.9 Amps.
      i. Standard backup time of resistive load: 7.2 min. (100% load), 12.0 min. (75% load)
2.08 SURFACE RACEWAY

A. It is anticipated that Surface raceway will be used in this project.
B. In remodeled areas, Surface Raceway will be used as a cable path. No exposed wire shall be permitted.
C. With the agreement of the Architect/Engineer, if a need arises to add telecommunications outlets in areas where the walls cannot be fished, the station wire serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, classrooms, corridors, or like facilities.
D. The metallic surface raceway shall have a screw applied base and have a snap on cover. Both the base and cover shall be metallic.
E. The raceway shall originate from a flush/surface mounted box as required.
F. The color of this raceway shall be electrical ivory or match the décor. All fittings including, but not limited to, extension boxes, elbows, tees, fixture boxes shall match the color of the raceway.
G. The raceway and all system devices must be UL Listed, exhibit nonflammable self-extinguishing characteristics, tested to specifications of UL94V-0 and be Category Compliant as defined by TIA/EIA 568B.
H. Refer to Section 26 05 33 “Raceway and Boxes for Electrical Systems” for metallic Raceway guidelines for this Project. Minimum bend radius shall be adhered to for UTP cable.
I. Provide Wiremold 4000 series or equal.

2.09 TELECOMMUNICATIONS GROUND

A. At each Telecommunications Equipment Rack, a rack-mounted "Telecommunications Grounding Busbar (TGB)" shall be installed by the Electrical Contractor. Refer to detail on drawings.
B. At each Telecommunications Equipment Rack, a wall-mounted busbar shall be installed as indicated on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall furnish and install all cables, connectors and equipment as shown on drawings and as specified above. It shall be noted that all cables shall be installed in continuous lengths from endpoint to endpoint. No splices shall be allowed unless noted otherwise.
B. Refer to Project Drawings which indicate termination location(s) within each building section.
C. It is the contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.
D. Beginning installation means contractor accepts existing conditions.
E. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment is to include, but not limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices, which may move or wear in a manner to pose a hazard to the cable, shall not be used.
F. All cable shall be pulled by hand unless installation conditions require mechanical assistance.

G. The contractor will be responsible for identifying and reporting to the Architect/Engineer any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, raceway or other hardware must be repaired by the Contractor. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced by the contractor to match color, size, style and texture.

H. Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.

I. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.

J. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed. If any installed cable is kinked to a radius less than recommended dimension it shall be replaced by the contractor with no additional cost to the project.

K. All wiring shall be run "free-air", in conduit, in a secured metal raceway, in cable tray as designated on the floorplan(s). All cable shall be free of tension at both ends.

L. Avoid abrasion and other damage to cables during installation.

M. Pulling Lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

N. The Cable system will be tested and documented upon completion of the installation as defined in the Section below.

O. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

P. Should it be found by the Engineer, that the materials or any portion thereof, furnished and installed under this contract, fail to comply with the specifications and drawings, with the respect or regard to the quality, amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by the Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

3.02 SYSTEM TOPOLOGY AND CABLE SIZE REQUIREMENTS

A. Station Cabling
1. Information Outlets cables with copper media (Voice & Data UTP) shall be located as detailed on the Project Drawings.
2. The Bidder in determining materials quantities and routing should utilize these documents.
3. Station Cabling on each Floor shall be routed to the Electrical Room on that floor.
4. Station cables shall be run to the Information Outlet from the Telecommunications Room serving each area in conduit, free-air above drop ceiling, or in cable tray.
5. The maximum station cable drop length for Data and Voice UTP Category 6 shall not exceed 295-feet (90-meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing station cabling in a fashion as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Engineer prior to installation. Changes to the plan shall be approved by the Engineer.
6. All cables shall be installed splice-free unless otherwise specified.
7. During pulling operation an adequate number of workers shall be present to allow
cable observation at all points of duct entry and exit as well as the feed cable and
operate pulling machinery.
8. Avoid abrasion and other damage to cables during installation.
9. All cable shall be free of tension at both ends. In cases where the cable must bear
some stress, Kellom grips may be used to spread the strain over a longer length of
cable.
10. Where installed free-air, installation shall consider the following:
   a. Cable shall run at right angles and be kept clear of other trades work.
   b. Cables shall be supported according to code utilizing "J-" or "Bridal-type"
      mounting rings anchored to ceiling concrete, piping supports or structural steel
      beams. Rings shall be designed to maintain cables bend to larger than the
      minimum bend radius (typically 4 x cable diameter).
   c. Supports shall be spaced at a maximum 4-foot interval unless limited by building
      construction. If cable "sag" at mid-span exceeds 6-inches, another support shall
      be used.
   d. Cable shall never be laid directly on the ceiling grid or attached in any manner to
      the ceiling grid wires.
   e. Cables shall not be attached to existing cabling, plumbing or steam piping,
      ductwork, ceiling supports or electrical or communications conduit.
   f. All cables shall be PLENUM rated.
11. Manufacturer's minimum bend radius specifications shall be observed in all
    instances.
12. Care should be taken in the use of cable ties to secure and anchor the station
    cabling. Ties should not be over tightened as to compress the cable jacket. No
    sharp burrs should remain where excess length of the cable tie has been cut.
13. Cable sheaths shall be protected from damage from sharp edges. Where a cable
    passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
14. A coil of 4 feet in each cable shall be placed in the ceiling at the last support (e.g. J-
    Hook, Bridal Ring, etc.) before the cables enter a fishable wall, conduit, surface
    raceway or box. At any location where cables are installed into movable partition
    walls or modular furniture via a service pole, approximately 15-feet of slack shall be
    left in each station cable under 250-feet in length to allow for change in the office
    layout without re-cabling. These "service loops" shall be secured at the last cable
    support before the cable leaves the ceiling and shall be coiled from 100% to 200% of
    the cable recommended minimum bend radius.
15. At all Telecommunication Rooms (TR), approximately 15-feet of slack shall be left in
    each station cable under 250-feet in length to allow for changes in the
    telecommunication room layout without re-cabling. These "service loops" shall be
    secured to the ladder rack, with “J” hooks, or “D” rings above the equipment, racks,
    and patch panels and shall be coiled from 100% to 200% of the cable recommended
    minimum bend radius.
16. To reduce or eliminate EMI, the following minimum separation distances from ≤480V
    Power lines shall be adhered to:
   a. Twelve (12) inches from power lines of <5-kVa.
   b. Eighteen (18) inches from high voltage lighting (including fluorescent).
   c. Thirty-nine (39) inches from transformers and motors.
17. All openings shall be sleeved and firestopped per prevailing code requirements upon
    completion of cable installation.
18. IMPORTANT: Within the room in which Data Cabling is to be terminated, Hook and
    Loop (e.g. “Velcro”) ties only shall be used from room entry to the point of
    termination. This is to facilitate the addition of future cables.

B. Information Outlet
1. Information Outlets shall be flush mounted on wall-mounted boxes, and on Surface
   Raceway.
2. Any outlets to be added where these conditions are not met shall be positioned at a
height matching that of existing services or as directed otherwise by the Site Coordinator and the Engineer. Nominal height (from finished floor to center line of Outlet) in new installation shall be as follows:

a. Standard IP Voice & Data Outlet - 18-inches
b. Wall-Mounted Telephone Outlet (Standard IP Voice only) - 46-inches.
c. Wall-mounted Telephone Outlets for ADA:
   Approach head on - per ADA regulations
   Approach parallel - per ADA regulations

C Single-Mode Optical Fibers (Install between Electrical Room #109 and Wall-Mounted Equipment Rack located in Flex Lab #107).

1. Single mode fiber type (# of strands as noted on drawings), doped silica core surrounded by a concentric glass cladding.
2. ISO/IEC Type OS2 (Indoor/Outdoor)
4. Fiber Coating Diameter: 250 um (nominal primary coating), 900 um (nominal) secondary coating (tight buffer). All coatings shall mechanical strippable without damaging the optical fiber.
5. Must be rated for both Indoor and Outdoor installation.
6. Must be **Plenum** rated.

D. Fiber Optic Connector

1. The Optical Connector shall be LC-type.
2. The connector ferrule shall be ceramic or glass-in-ceramic, metallic, or equivalent. The optical fiber within the connector ferrule shall be secured with an adhesive or mechanical process to prevent pistoning and other movement of the fiber strand.
3. The Connector Body shall be a Composite material.
4. The attenuation per mated pair shall not exceed the following values:
   a. Multimode 0.5 dB (individual); 0.3 dB (average)
   b. Single Mode (if applicable) 0.5 dB (individual); 0.3 dB (average)
5. These values shall hold throughout the Cable System. Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
6. The connector shall meet the following performance criteria:
   a. Test Procedure Max. Attenuation Change
   b. Cable Retention (FOTP-6) 0.2 dB
   c. Mating Durability (FOTP-21) 0.2 dB
   d. Impact (FOTP-2) 0.2 dB
   e. Thermal Shock (FOTP-3) 0.2 dB
   f. Humidity (FOTP-5) 0.2 dB
7. Color of Connector Body or strain-relief boot shall indicate fiber type as follows:
   a. Multimode (50-micron; LASER-optimized) OM3 – Aqua
   b. Single-mode – Blue
8. Single-mode only (if applicable):
   a. Connector End-Face finish shall be a high-performance, spherically polished design (e.g. Ultra-Physical Contact; UPC).
   b. Reflectance shall be -40 dB or better when mated with a patch-cord made up of connectors of comparable design.

E. Fiber optic patch panel

1. All terminated fibers shall be mated to Duplex LC. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types.
2. Color of Connector Coupling (all except ST-type) shall indicate fiber type as follows:
   a. Multimode (50-micron; LASER-optimized) OM3 – Aqua
   b. Single-mode – Blue
   c. Patch Panels shall be rack-mounted.
3. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and drawings - including
those not terminated (if applicable). Connector panels and connector couplings (sleeves, bulkheads, etc.) adequate to accommodate the number of fibers to be terminated shall be furnished and installed by the contractor, and/or those included in "Bid Alternates" (if applicable).

4. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.

5. The patch panel enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer’s recommended minimums or 1.2", whichever is larger.

6. Access to the inside of the patch panel enclosure during installation shall be from the front and/or rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.

7. All Patch Panels shall provide protection to both the “facilities” and “user” side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (e.g. Backbone, Riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.

8. Where “Loose Buffered” cables are installed, the 250 µm coated fibers contained in these cables may be terminated either by (1) splicing of factory-terminated cable assemblies (“pigtails”) or (2) the use of a “fan-out” kit. In the latter approach, individual fibers are to be secured in a protective covering - an Aramid reinforced tube for example - with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and sub-assemblies are secured to prevent damage. Splicing shall be by the “fusion” method. Individual splice loss shall not exceed 0.3 dB for multi-mode fibers. Direct termination of 250 µm coated fibers shall not be permitted.

9. Where splicing of the cabling at system end points is a requirement of the installation, the Termination Enclosure shall incorporate a mechanism for securing the Splice Tray(s) and fiber slack. The Splice Tray and fiber slack shall not be accessible from the “user” side of the enclosure.

F. Cable Runway
1. Sometimes referred to as “Ladder Rack”, Cable Runway is used for support and routing of cabling within a Telecommunications Equipment Room.
2. Construction: Rungs welded to tubular stringers.
3. Material: 0.065-inch thick steel
4. Stringer Height - 1.5 inches.
5. Rung Spacing - 9 inches on center.
6. Finish: Manufacturer’s standard epoxy paint or baked-polyester powder coat.
7. Color: Black
8. Width: 12”.

G. Flexible Nonmetallic Innerduct And Fittings
1. Flexible Non-metallic Innerduct (e.g. “Innerduct”) may be used as follows:
2. To segment conduit(s), increasing their capacity,
3. As protection to backbone fiber optic cables when installed in cable tray, and/or
4. As protection to fiber optic cable(s) within equipment rooms and Telecommunications Rooms.
5. Innerduct shall be corrugated.
6. Where not installed in a continuous length, innerduct segments should be spliced using couplings designed for that purpose.
7. Any vacant innerduct shall be equipped with a pull cord and capped at all ends to inhibit the entry of water and contaminants.
8. Nominal duct size shall be 1-inch (minimum).
9. Innerduct should be rated (e.g. General, Flame-retardant, Riser or Plenum) as required by the installation environment. Riser and Plenum innerduct shall be of a
3.03 CABLE TERMINATION

A. General
1. At the Equipment Rack located in Electrical Room #109, all Data and IP Voice Cables shall be positioned on termination hardware in sequence of the Outlet I.D. starting with the lowest number. Exceptions to the sequencing of terminations is allowed only with the permission of the A/E.
2. Termination Hardware (Blocks and Patch Panels) Positioning and Layout must be reviewed and approved by the Engineer prior to construction. The review does not exempt the Contractor from meeting any of the requirements stated in this document.

B. Cable Termination – IP Voice UTP
1. IP Voice pairs shall terminate on patch panels at the rack in the Telecommunication Room. The contractor shall coordinate the placement of patch panels with the Engineer in order to integrate with other cabling.
2. Patch Panels shall be provided to accommodate a minimum of 20% growth in the quantity of stations relative to the initial installation.
3. The contractor shall furnish and install cable management hardware (e.g. D Rings and cable guides) to neatly and securely route the cable to the cable termination hardware.
4. The Height of the Voice Termination Field shall not exceed 6-feet (72-inches) above floor level to facilitate cable maintenance.
5. Patch panels on which Station Cabling are terminated shall be positioned in separate columns. Backbone Cabling should be positioned to the Left; Station cabling to the Right and be in close proximity as to simplify installation and subsequent tracing of cross-connect wiring. Where new cabling is to be integrated with existing cabling, it will be the responsibility of the Contractor, in cooperation with the Owner, to coordinate placement of Voice Termination hardware.
6. Cables shall be fed from below the Termination Hardware in a manner that will facilitate growth.
7. Horizontal Troughs incorporating split plastic distribution rings shall be provided by the Contractor to accommodate routing of jumpers. Troughs shall be positioned at the top of each column of termination blocks and between each 100-pair wiring block. Rings shall be positioned between the Backbone and Station blocks for vertical routing of jumpers and/or cross-connect wiring.
8. The installer shall insure that the twists in each cable pair are preserved to within 1.0-inch of the termination for all IP Voice UTP cables and within 0.5-inch for Category 6 cables. The cable jacket shall be removed only to the extent required to make the termination.

C. Cable Termination - Data UTP
1. Data Patch Panels shall be designed and installed in a fashion as to allow future station cabling to be terminated on the panel without disruption to existing connections.
2. Data Patch panels shall be sized to accommodate a minimum of 20% growth in the quantity of stations relative to the initial installation.
3. At Information Outlets and Data Patch Panels, the installer shall insure that the twists in each cable pair are preserved to within 0.5-inch of the termination for Data cables. The cable jacket shall be removed only to the extent required to make the termination.

D. Equipment Racks (4-Post Only)
1. Equipment racks shall be furnished and installed as follows:
2. The Contractor shall bolt the rack to the wall/floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each.
Rack shall also be stabilized by extending a brace extending to the ceiling if required. Alternately, overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.

3. A space between the rack upright and the wall (~4") should be planned to allow for cabling in that area. The rear of the rack should be ~30" minimum from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed should be brought to the attention of the Engineer for resolution prior to installation.

4. All hardware and equipment are to be mounted between 18" and 79" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware should be reviewed and approved by the Engineer and Site Coordinator(s) prior to installation.

5. Equipment Rack shall be equipped with cable management hardware on both the front and back of rack as to allow an orderly and secure routing of twisted pair cabling to the data patch panels. At minimum, one such Horizontal Jumper Management Panel shall be installed by the Contractor.

6. The rack shall be grounded to the Telecommunications Ground Busbar (TGB) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket or GREEN jacket with one or more yellow stripes).

7. Provide Two (2) wall-mounted equipment racks as noted on drawings in Flex Lab #107 and Electrical Room #120.

E. Identification and Labeling
1. Refer to Section 26 05 53 “Identification for Electrical Systems” for Identification and Labeling guidelines for this Project.
2. All Copper Station Cables, Outlet Faceplates and Termination components (e.g. Voice Field & Data Patch Panel) shall be clearly labeled.
3. Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used.

F. Work by Owner
1. Point-Over-Ethernet Switches shall be provided and installed by the owner.

G. Cooperation
1. The Contractor shall cooperate with other trades in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost, provided such decision is reached prior to actual installation. The Contractor shall check the location of electrical outlets with respect to other installations before installing.

3.04 TESTING AND ACCEPTANCE

A. The contractor is responsible to perform acceptance tests as indicated below for each sub-system (e.g. backbone, station, etc.) as it is completed.

B. All tests shall be documented.

C. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type including equipment to be used, set-up, test frequencies or wavelengths, results format, etc. The method of testing shall be approved by the Engineer.

D. The Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. The contractor shall provide the Engineer with a written certification that this inspection has been made.

E. The Contractor shall conduct acceptance testing according to a schedule coordinated with the DSF. Representatives of the Owner may be in attendance to witness the test procedures. The contractor shall provide a minimum of one (1) week advance notice to the Engineer as to allow for such participation. The notification shall include a written description of the proposed tests including copies of blank test result sheets to be used.
Failure to provide the above information shall be grounds for the Owner/Engineer to reject any and all Documentation of Results on related testing and to require a repeat of the affected test.

F. Tests related to connected equipment of others shall only be done with the permission and presence of Contractor involved. The Contractor shall ascertain that testing only as required to prove the wiring connections are correct.

G. The Contractor shall provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Engineer, the contractor shall provide copies of the original test results.

H. All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the contractor. The applicable tests shall then be repeated.

I. Should it be found by the Engineer that the materials or any portion thereof furnished and installed under this contract fail to comply with the specifications and drawings, with the respect or regard to the quality, amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by the Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

3.05 DOCUMENTATION

A. Upon completion of the installation, the contractor shall provide three (3) full Documentation Sets to the Western Technical College IT Department for approval.

3.06 AS-BUILT CONSTRUCTION DRAWINGS

A. Drawings included with the specifications set shall be modified by the contractor to denote as-built information.

B. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

C. The Architect through the Consultant will provide floor plans in paper formats on which as-built construction information can be added. These documents will be modified accordingly by the contractor to denote as-built information as defined above and returned to the Consultant for acceptance.

D. The Contractors shall annotate the base drawings and return to the A/E in hard copy form.

E. Each drawing submitted by the Contractor as part of the Project Documentation shall be identified as an "As-built" drawing and include the following (1) The Contractor name and/or logo (2) The date of the drawing.

F. All documentation, including hard copy and electronic forms shall become the property of the owner.

3.07 WARRANTY

A. This Contractor shall guarantee all materials, equipment, etc., two (2) years from date of substantial completion of this work. This guarantee shall include all labor, material and travel time. See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee Documents for further requirements.

END OF SECTION 27 00 00
SECTION 28 3100
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.02 RELATED WORK

A. The work covered by this section of the specifications shall be coordinated with the related work as specified elsewhere under the following project sections:

Section 26 05 00 - Common Work Results for Electrical
Section 26 05 26 – Grounding and Bonding for Electrical Systems
Section 26 05 29 – Hangers and Supports for Electrical Systems
Section 26 05 33 – Raceway and Boxes for Electrical Systems
Section 26 05 53 – Identifications for Electrical Systems
Section 26 27 26 – Wiring Devices

1.02 DESCRIPTION OF WORK

A. New addressable Horn/Strobe fire alarm devices shall be connected to an existing 'NOTIFIER' fire alarm control panel located in Electrical Room #109 with the following major components installed as follows:

1. Addressable Manual pull stations to be installed at all new required exit doors.
2. Combination Horn/Strobes and Strobes-Only will be installed throughout the new addition for Notification Devices.
3. HVAC duct detectors will be installed as required by Code.
4. Addressable Smoke and Heat detectors will be installed in strategic locations throughout the building.
5. It is anticipated to use EMT conduit and Wiremold type for surface wiring in exposed areas.
6. Addressable interface modules will be provided as required.
7. Notifier Manufacturer Supplier Representative Contact:

Fire Protection Specialists
1906 Commercial Street
Bangor, WI 54614
608-781-3137

B. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.

C. The New Fire Alarm System shall be configured as a local protective signaling system, as defined in NFPA-72, and shall use/incorporate the following features, as a minimum:

1. The latest addressable technology (detectors/sensors and modular panel equipment) currently available from the manufacturer
2. Non-Coded, Horn-type Audible Notification Appliances
3. Signaling Line Circuits (SLCs), connecting addressable field points to the associated Fire Alarm Control Panel, shall be configured as NFPA style 4 (Class B), with point supervision.
4. Initiating Device Circuits (IDCs) shall be limited to short runs from Monitor Modules to the connected device, unless specifically stated otherwise herein, and shall be configured as NFPA Style B (Class B), with individual zone supervision.
5. Data Circuits to Annunciators shall be configured as NFPA Style 4 (Class “B”). All annunciators shall be fully supervised.

E. Manufacturers: Notifier is the only accepted manufacturer for this project.
1.03 REGULATORY REQUIREMENTS

A. The complete installation shall conform to the applicable sections of the latest edition of the following Codes and Standards:

1. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):
   - NFPA-70 National Electrical Code (NEC) Generally, and Article 760 in particular
   - NFPA-72 National Fire Alarm Code
   - IBC International Building Code
   - IFC International Fire Code
   - IMC International Mechanical Code

2. STATE OF WISCONSIN – DEPARTMENT OF SAFETY AND PROFESSIONAL SERVICES (DSPS)

3. NATIONAL ELECTRICAL MANUFACTURER’S ASSOCIATION (NEMA)

4. UNDERWRITERS’ LABORATORIES, INC. (UL)
   - UL-864 Control Units for Fire Protective Signaling Systems
   - UL-268 Smoke Detector for Fire Protective Signaling Systems
   - UL-217 Smoke Detectors for Single and Multiple Station
   - UL-521 Heat Detectors for Fire Protective Signaling Systems
   - UL-464 Audible Signaling Appliances
   - UL-1971 Visual Signaling Appliances
   - UL-38 Manually Actuated Signaling Boxes
   - UL-1481 Power Supplies for Fire Protective Signaling Systems

1.04 MANUFACTURER PROVIDED SERVICES

A. A manufacturer-trained service technician shall provide the following installation supervision. This Technician shall be certified by the equipment manufacturer, and shall have had a minimum of two (2) years of service experience in the fire alarm industry.

B. The technician's name shall appear on equipment submittals and a letter of certification from the fire alarm manufacturer shall be sent to the project engineer. The manufacturer's service technician shall be responsible for the following items:
   1. Pre-installation visit to the job site to review equipment submittals and verify method by which the system should be wired.
   2. Periodic job site visits to verify installation and wiring of system, and to perform any partial system programming – required to permit portions of the existing system to be removed.
   3. Upon completion of wiring, final connections shall be made under the supervision of this technician, and final checkout and certification of the system.
   4. At the time of final checkout, technician shall give operational instructions to the Owner and/or his representative on the system.
   5. All job site visits shall be dated and documented in writing and signed by the Electrical Contractor. Any discrepancy shall be noted on this document and a copy kept in the system job folder that shall be available to the Project Engineer any time during the project.

1.05 QUALITY ASSURANCE

A. Unless specifically stated otherwise, each and all items of the fire alarm system shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters’ Laboratories, Inc. (UL), and shall bear the UL label.

B. Notification Appliances shall be products of a single manufacturer.

C. In addition to previously listed UL standards, all control equipment shall be listed under the following UL Standards:
19021 Western Apprenticeship
Center Remodel

UL 864 Transient protection
UL 497B Isolated Loop Circuit Protectors. Where fire alarm circuits leave the building, additional Transient protection must be provided for each circuit.
UL 1481 Power Limited Applications.

1.06 QUALIFICATIONS

A. All equipment shall be supplied by a firm, which specializes in fire alarm and smoke detection systems with a minimum of five (5) years-documented experience. The company shall be an authorized distributor of the proposed equipment.

B. All work shall be performed by a licensed contractor, who is regularly engaged in the installation and servicing of fire alarm systems. Proof of five (5) years documented experience and of factory authorization to furnish and install the equipment proposed shall be furnished prior to contract award, if required by Western Technical College.

C. Contractor shall be located within three (3) hours of travel time or less from the site of this project.

1.07 SUBMITTALS

A. Under the provisions of Section 26 05 00 and Division 1, submit the following for approval prior to ordering any equipment in accordance with requirements of Division 1, General Conditions. Submit a total of ten (10) sets.

B. Copies of CAD Files (AutoCAD, latest version, or DXF Format) for the Fire Alarm floor plans will be made available to the successful bidder for preparation of the required shop drawings and as-builts.

C. REQUIRED SUBMITTAL MATERIALS

1. The following items, and any additional items required per Section 26 05 00, shall be included within the submittal package:

2. Although they may be submitted under separate cover, Submittal Brochures / Booklets / Binders and Shop Drawings shall be submitted together, and shall be treated as a complete set.

3. COVER SHEET:
   a. The submittals shall contain a cover sheet, which shall include the following information:
      - Submittal Date
      - Specification Section(s)
      - Fire Alarm Contractor (Contact Name, name, address, and telephone number)
      - Electrical Contractor (Contact Name, name, address, and telephone number)
      - Project Name, Project City, Project State, and Project Address.

4. TABS AND TABLE OF CONTENTS:
   a. The Table of Contents shall appear immediately behind the Cover Sheet, and shall contain a complete listing of all of the tabs contained within the binder / booklet.
      - Tabbed index sheets shall be inserted into each of the binders, such that each binder is clearly sub-divided into sections. Tabbed sections shall be provided, at minimum, for the following:
      - One section for each building – ALL submittal data, which applies to any particular building, shall be located within the tabbed section for the corresponding building. All submittal data within each “building” section shall appear in the same order.
      - One section for manufacturer’s data sheets – divided into sub-sections for the following:
        - Panel Equipment (Panels, Panel Components / Modules, Printers, Annunciators, etc.)
- Addressable Field Devices (Initiating and Control / Monitoring / Isolation)
- Non-Addressable Field Devices (Initiating Devices, relays, etc.)
- Notification Appliances
- Fire-Fighter Communications Equipment if applicable

5. EQUIPMENT LIST:
   a. A complete equipment list of all components, including the following: Quantity, Manufacturer, Part Number, and Description. If the supplier uses different part numbers from those of the actual manufacturer, the actual manufacturer and part numbers as they appear – marked on the shipping box / packages, shall also be identified on this list.
   b. Each Equipment List shall include a complete listing of the modules, components, and software included for each modular Fire Alarm Control Panel, Network Panel, Transponder, Outboard Gear Panel or Annunciator. Such items shall be listed in a manner that clearly indicates that such items are parts of / components of a larger unit. Simply stating a single part number and description for such panels shall be unacceptable.
   c. A separate list shall be included for each section, with items grouped by system.
   d. For projects involving multiple systems, separate equipment lists shall be provided - one for each system.
   e. Spare Parts shall also be listed separately, and shall be identified clearly as “Spare Equipment”.

6. PRODUCT DATA:
   a. Manufacturer's product data sheets, and equipment description of all system components. These data sheets shall be highlighted or suitably marked, so that included items and options are indicated. On data sheets that include multiple products, products that are not used shall be crossed out.
   b. Product Data Sheets shall be organized, in order, corresponding to the FIRST occurrence of the corresponding item on the equipment list.

7. SEQUENCE OF OPERATION:
   a. Complete sequence of operations of all functions of the system. This sequence of operation shall be custom-created for this particular job.

8. BATTERY CALCULATIONS:
   a. These calculations shall clearly illustrate both the Standby and Alarm loads, due to the various field devices and panel components / modules. It is generally recommended to submit such calculations in a “spreadsheet” format. These calculations shall include any reserve / additional capacity, as required elsewhere within these specifications. Final results shall indicate both the minimum battery capacity required and the capacity actually provided.

9. ADDRESSABLE DEVICE / DESCRIPTOR LIST - Prior to programming the system, submit a chart or printout, listing every system address provided for purposes of alarm initiation, status monitoring, supervised signaling, and auxiliary controls. This printout shall include the corresponding device type and field programmable “custom labels”, as they will be displayed on the New System – at the FACP and Local Annunciator. The addresses listed within this document shall directly correspond to the addresses marked on the submitted floor plan drawings. This list will be modified as needed by the Owner and returned to the contractor for final programming in to the system.

10. NAC WIRE DROP CALCULATIONS:
    a. Calculations shall be provided for all Notification Appliance Circuits (NAC) in the new addition. It is recommended that this calculation should follow a “spreadsheet” format, and should clearly indicate the following:
       ✓ The name of the circuit
       ✓ Point of origin of the circuit
       ✓ Complete list of all devices served by the circuit, including location and type of each device
       ✓ Alarm Current Draw for each device, at the applied voltage
- Applied Voltage (Based on anticipated battery voltage after specified standby & alarm operation)
- Acceptable Operating Voltage for each type of device on circuit
- Calculated Voltage at each device on circuit
- These calculations should mathematically prove that all Notification Appliances on the circuit will receive acceptable power for proper operation, under "worst-case-scenario" conditions.

11. SHOP DRAWINGS:
   a. All submitted drawings shall be created using CAD, and shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are the same on all drawings. All drawings must be submitted and approved by the engineer before ordering or fabrication starts, but such approval will not waive any specification requirements unless specifically stated. A/E shall provide copies of the floor plan drawings, in AutoCAD or DXF format, to the successful bidder.
   b. Each and every sheet of the Shop Drawings shall be clearly and prominently identified as "SHOP DRAWINGS – PREPARED BY: (insert name of contractor firm preparing the shop drawings)" and shall be clearly and visibly different from the Contract Documents / Bidding Drawings. As a minimum, the name and company logo for the Electrical Contractor and the Fire Alarm Equipment Vendor should be added to each sheet, and a revision date shall be inserted on each sheet.
   c. The submitted Shop Drawings shall include the following types of drawings:

12. PROJECT-SPECIFIC DRAWINGS:
   a. Project-Specific Drawings. These drawings shall include the following:

13. SYSTEM RISER DRAWING:
   a. A separate riser drawing shall be furnished for each system. Each System Riser shall illustrate all fire alarm circuits, which serve the facility, and shall incorporate the following information, in a clear, concise format:
      - Point of origin of each circuit (usually a Panel, or a Module within a panel)
      - Circuit type and labeling
      - Area served by each circuit
      - Wire / cable type and size
      - Locations of Panelboards where primary system power is obtained
      - The following information for each Field Device:
         - Device Type
         - Circuit(s) to which device is connected
         - Locations of any End-Of-Line Resistor (EOLR)
         - (and the circuit terminated by any such EOLR)

14. BLOCK DIAGRAMS:
   a. Showing layout and operation of the entire system.

15. FLOOR PLANS:
   a. These drawings shall consist of edited versions of the Contract Documents, which shall include the following information:
      - Annunciator Location(s)
      - Panel Location(s)
      - Device Addresses - The addresses shown on these drawings shall directly correspond to the chart or printout, as specified previously, which spells out specific information about each device, including the field programmable "custom label".

16. TYPICAL DEVICE / MODULE WIRING DETAILS:
   a. Component and module wiring diagrams – intended to illustrate terminations and wiring connections to each typical Field Device (Detectors, Notification Appliances, etc.), and each typical panel component / module utilized within the system. This set of drawings shall only include diagrams for modules and components, which are actually used in the provided system(s).
   b. These drawings shall incorporate clear labeling / nomenclature, which shall clearly indicate the corresponding field device or module, to which it corresponds.
17. OMISSION OF ANY OF THE ABOVE MATERIALS FROM THE SUBMITTALS SHALL RESULT IN AN IMMEDIATE REJECTION OF THE SUBMITTALS FOR THIS PROJECT. If the EC / FAC has any questions concerning the preparation of these materials, please contact the Engineer.

1.08 DEPARTMENT OF SAFETY AND PROFESSIONAL SERVICES PLAN REVIEW

A. REQUIRED DOCUMENTS
1. This project requires a submittal to the Department of Safety and Professional Services for review and approval. The following details the requirements of the contractor and the A/E with regard to the fire alarm Department of Safety and Professional Services submittal.

B. CONTRACTOR’S RESPONSIBILITY
1. Department of Safety and Professional Services approval is required prior to the start of fire alarm system construction. The contractor shall prepare and submit the required documents in a timely fashion to meet this requirement. If the contractor starts fire alarm system construction before approval is given by the Department of Safety and Professional Services, the contractor is responsible for all additional fees required by the Department of Commerce.

2. Initially, prepare one set of the Department of Safety and Professional Services fire alarm submittals and send it to the A/E for approval before proceeding with actual submittal to DSPS.

3. Contractor shall follow DSF’s CAD standards when preparing fire alarm shop drawings, using information consistent with the project’s construction drawings.

4. After obtaining A/E approval to proceed with the Department of Safety and Professional Services fire alarm submittal, prepare four (4) sets of the fire alarm shop drawings as approved by the A/E that will be sent to the Department of Safety and Professional Services by the contractor. These shop drawings shall be stamped, signed and dated by a Wisconsin registered architect, professional engineer or electrical designer taking responsibility for the shop drawings. Signing and sealing shall comply with SPS 361.31(1). Note that each shop drawing copy must be stamped, signed and dated unless there is a drawing index sheet, in which case only the four index sheets need to be stamped, signed and dated. Where the submitter is both the designer and installer of the fire alarm system, a signature only will suffice [ch. 443.14(6), Stats.]. It shall be an original signature and date.

5. Prepare one bound booklet of the fire alarm system device cut sheets and all calculations (indicating device power calculations, voltage drop calculations and battery calculations). These booklets do not need to be stamped, signed or dated.

6. Prepare a letter of transmittal listing all items being sent to the Department of Safety and Professional Services. Copy the A/E on the letter of transmittal only.


8. Calculate the SDB-118 submittal fee; write a check for the appropriate amount, payable to Safety and Professional Services.

9. Request a review date with Department of Safety and Professional Services, Division of Safety and Buildings by emailing the completed first page of the review application, SBD-118, to planschedule@commerce.state.wi.us, or, fax it to 877-840-9172.

10. Assemble the submittal and send the documents described in items (d), (e), (f), (g) and (h) above to the Department of Safety and Professional Services at the appropriate address shown on at the bottom of DBS-118.

11. If requested by DSF, A/E, Department of Safety and Professional Services or its authorized representative, additional data pertaining to the construction, materials and equipment shall be submitted to the A/E to substantiate conformance to DSPS 361 code.

C. PLAN REVIEW FEES
1. Fees shall be determined in accordance with Table 302.31-1 or Table 302.31-2 found in Chapter SPS 302 of the Wisconsin Administrative Code.
2. Reduced plan review fees (Table 302.31-2) may be utilized for projects in municipalities that perform inspections as an agent of the Division of Safety & Buildings.
3. A list of “Delegated Municipalities” that perform inspections can be found at:
5. Reduced fees (Table 302.31-2) do not apply to State-owned buildings.
6. In addition to the plan review fee, a plan entry fee of $100 shall be included with each submittal.
7. Per SPS 302.10, plan review fees shall be doubled for projects where the installation, erection or construction was initiated without the required Departmental approval.

D. WHAT TO SUBMIT
1. Four (4) sets of properly signed/sealed fire alarm plans.
2. In an effort to limit handling and mailing costs, the submitter may opt to submit one (1) complete set of plans and three (3) index sheets. The plan set will be retained. A copy of the approval letter will be attached to the index sheets and returned. It shall then be the responsibility of the submitter to properly attach the approval and index page to plans matching the copy on file with the Department.
3. A maximum of five (5) plan sets may be submitted. Additional plan sets (in excess of 5) will incur a $25/set fee.
4. One (1) set of battery calculations.
5. One (1) set of voltage-drop calculations for each notification circuit.
6. One (1) copy of applicable material data sheets.
7. A detailed, project-specific ‘Sequence of Operation’ which clearly identifies all functions of the fire alarm system, including the transmission of alarm, supervisory and trouble signals to an approved supervising station.
8. A completed SBD-118 application form. The application must identify the Transaction ID No. related to the parent building review approval. Fire alarm submittals for new construction, building additions or building alterations cannot be reviewed prior to building plan approval.
9. The original supervising professional’s signature for the building project is applicable to fire alarm submittals and a separate signature is not required. Standalone fire alarm system submittals do not require a supervising professional.
10. Plan review fee.

E. FORMS
1. SBD-118 (R11/11) can be downloaded from: http://dsps.wi.gov/sb/docs/sb-Form118App.pdf (PDF) or http://dsps.wi.gov/sb/docs/SB-Form118App.doc (Word)
3. For scheduling of building, HVAC, and fire plans, use the electronic online request for commercial building plan appointments: http://dsps.wi.gov/sb/SB-DivPlanReview.html
4. Once approved, Safety and Buildings will retain one of the sets, and will return three sets, which shall be distributed as follows:
   a. (1) copy shall be retained by the fire alarm contractor on-site, and shall be used as a reference / made available to any Department of Safety and Professional Services inspectors, who may make periodic inspection visits to the site.
   b. (1) copy shall be forwarded to the Owner for their records.
   c. (1) copy shall be retained by the Division 26 electrical contractor, for their records. If the Division 26 electrical contractor and the fire alarm contractor are the same firm, this copy shall be kept on site, at or near to the Fire Alarm Control Panel.

1.09 PROJECT RECORD DRAWINGS

A. Installing Electrical Contractor shall submit to the Western Technical College Construction Superintendent the as-built drawings for the entire work done under this project prior to final payment.
B. Work shall be done on Auto CAD using the contract drawings provided to the Contractor by A/E in the form of Auto CAD files. A hard copy of same shall also be submitted.

C. These drawings shall show:
   1. Locations and addresses of Initiation Devices, Notification Appliances, isolation devices, status-monitoring devices, supervised signaling devices, and auxiliary control devices.
   2. Circuit and Address information for each field device listed above.
   3. Conduit layout and size
   4. Number/size/type of conductors in each conduit run
   5. Riser diagrams
   6. Location of end-of-line devices

D. Riser diagrams shall include location of 120VAC panel, panel designation and circuit number used to feed each fire alarm panel.

E. Riser diagrams shall include locations (room or area number) of notification, initiating, end-of-line devices and addresses for all addressable field devices.

F. Also see requirements in Division 1, General Conditions.

1.10 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
   1. A material guide, which shall contain the replacement part numbers and description of all components used. If this information is included in an instruction section for any of the equipment, it will not be necessary to duplicate the list. In either case, the parts list shall be associated with its respective chassis, modules or kit wherein it is found. A total listing of parts without such grouping will not be acceptable.
   2. Catalog data or literature
   3. Manufacturer's operating instructions.
   4. Manufacturer's maintenance instructions
   5. Installation instructions
   6. Name, address and telephone number of source for parts (i.e. keys, guards, etc.) not supplied by the Fire Alarm Manufacturer
   7. Copies of all approved shop drawings
   8. An updated copy of the submitted sequence of operation, revised to reflect any implemented changes

1.11 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Receive equipment at job site; verify applicable components and quantity delivered.

B. Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of enclosure finish.

C. Do not install damaged equipment.

D. Store equipment in a clean, dry space and protect from dirt, fumes, water, and construction debris and physical damage. Make arrangements with the Owner at the pre-construction meeting for storage of equipment on the premises

1.12 SUPERVISION

A. The system shall report a TROUBLE condition when any supervised circuit becomes disarranged, disconnected, or is manually disabled or overridden. Each supervised circuit shall be independently protected for short-circuit conditions, and shall be arranged so that faults on any one circuit do not prevent the proper operation of any other circuit in the system.

B. The following devices/circuits shall be supervised, as a minimum:
   1. ALL communications links.
   2. ALL Signaling Line Circuits
3. ALL Initiating Device Circuits.
4. All sprinkler flow and tamper switches.
5. ALL Notification Appliance Circuits.
7. Remote Control Relays / Control Modules.
8. Primary, AC Incoming power to the system.
9. The system's batteries.
10. System Expansion Modules
11. Auxiliary module LED's.

C. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

D. Each independently supervised circuit shall include a discrete LCD readout, to indicate disarrangement conditions per circuit.

1.13 POWER REQUIREMENTS

A. Primary 120 VAC power, to all Fire Alarm equipment shall consist of dedicated branch circuits. These circuits shall be of a 3-conductor type, including a suitably sized green ground wire – SHARED NEUTRALS AND CONDUIT GROUNDS SHALL BE UNACCEPTABLE.

B. Each control panel shall receive 120 VAC power via a branch circuit in one of the building's panels. Each such branch circuit shall have a "breaker lock" to prevent accidentally de-energizing of the power to the fire alarm panel. Circuit breakers shall be painted red and labeled "FIRE ALARM". If more than one power circuit is used, each circuit shall be properly labeled as "FIRE ALARM", and shall also be labeled with additional information – in order to indicate which fire alarm equipment is powered from each such circuit.

C. All fire alarm power supplies, as well as any other supplemental power supplies, shall be installed in compliance with NFPA-70 – National Electrical Code (Latest Edition).

D. The panel shall include a disconnect switch for the AC power inside a locked enclosure near the panel or within the panel itself. This switch shall be labeled "Fire Alarm Power Disconnect".

E. Where the new control panel is to remain at same location as the existing panel, the contractor may re-use the existing branch circuit, if it meets the previously stated requirements stated above.

F. The control panel shall include 120 VAC electrical power surge and transient protection. If problems are anticipated, then the fire alarm equipment supplier shall provide suitable power filtering / suppression equipment, as recommended by the equipment manufacturer.

G. The system shall include sufficient back-up battery capacity to operate the entire system as follows, upon loss of normal 120 VAC power:
1. For panels, which are not connected to Dedicated Emergency Power (no Generator) Branch Circuits:
   2. The Panel and associated devices shall operate in a normal (non-Alarm) mode for a period of 24 Hours. After the 24-Hour normal period has expired, sufficient capacity shall remain, such that the panel and associated devices shall operate in an Alarm mode for a period of 10 minutes.

H. The panel shall include a power-limited, filtered and regulated battery charger. The charger shall charge a fully discharged battery to 70% in 12 hours. The panel shall monitor for AC fail / disconnect, low/no battery and high battery and shall distinctly display or annunciator any abnormality. The main panel power supply shall include sufficient power to power all connected field devices and an additional 25% spare power for future additions without the need to add additional boards or booster power supplies. The charger shall be designed specifically for, or shall be properly configured for the provided batteries, which shall be of one of the following types:
1. Sealed, Immobilized Electrolyte Lead-Acid type ("Gel-Cells") – Types which require fluid level maintenance, or which vent significant amounts of Hydrogen shall be unacceptable.
2. Nickel-Cadmium (Ni-Cad) batteries.
I. All batteries used in conjunction with the fire alarm system shall be installed in accordance with NFPA-70 – National Electrical Code (Latest Edition).

J. If these batteries are not located within or immediately adjacent to the fire alarm equipment, the location of such batteries shall be clearly indicated within the fire alarm equipment served by them, and the batteries and their enclosure shall be clearly marked as “FIRE ALARM”

K. All external circuits requiring system-operating power shall be 24VDC and shall be individually supervised and fused at the control panel.

PART 2 - PRODUCTS

2.01 ENCLOSURES

A. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.

B. Cabinet shall be equipped with locks and transparent door panel providing tamper proof enclosure yet allowing full view of the various lights and controls as required above.

2.02 MULTIPLEX/INTELLIGENT FIRE ALARM CONTROL PANEL (FACP): (EXISTING NOTIFIER – MODEL #NFS-320)

2.03 OPERATION: MULTIPLEX/INTELLIGENT FIRE ALARM SYSTEM (EXISTING)

2.04 REMOTE ANNUNCIATOR PANEL (EXISTING)

A. GENERAL INFORMATION

1. Where shown on the plans, re-install existing Annunciator FAAP.

2.05 NAC BOOSTER PANELS (Remote Power Supplies):

A. Where they are used, “NAC Power Booster Panels” shall be individually supervised. Interconnecting NAC Booster Panels in a manner, which prevents identification of individual panel TROUBLE conditions, shall not be approved. NAC Booster Panels shall be wired to dedicated Power Branch Circuits.

B. If NAC Booster Panels are needed at locations other than those identified on the construction drawings, the Electrical Contractor shall obtain approval for their proposed installation locations. At such locations, the EC shall provide any required circuit breakers, associated power wiring, and local smoke detection at the approved location. Power shall be obtained from the nearest available emergency panel. The cost of such equipment and installation shall be included within the base Electrical Bid.

C. Provide additional NAC Booster Panels as required.

2.06 MULTIPLEX/INTELLIGENT PERIPHERAL DEVICES

A. GENERAL INFORMATION

1. All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder the operation of other system devices.

B. DEVICE IDENTIFICATION

1. Each intelligent device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address shall not be acceptable.

2. Device addressing schemes which use permanently-imbedded, electronically-identifiable “serial number” which is similar to the address imbedded within Personal Computer Network Interface Cards shall be acceptable.

3. Fire Alarm Systems utilizing hand-held or briefcase-style programming tools. Which are used to electronically assign addresses and/or programming parameters to devices shall
be acceptable. However one such programmer tool shall be provided to the Owner at no additional cost.

4. The address along with the loop number and end-of-line device if present shall be indicated, and be visible from the ground, on the device in the field using machine generated marking. Contractor shall provide a sample of such labeling scheme before using it.

5. End-of-Line devices shall also be identified by means of permanent, machine generated label, affixed to the device.

6. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate tapping and the addition of an intelligent device between existing devices requires re-programming all existing devices beyond added device.

7. The system must verify that proper type device is in place and matches the desired software configuration.

C. INTELLIGENT DETECTORS - GENERAL

1. Smoke and heat detectors must be approved by the Engineer prior to installation.

2. Each detector shall incorporate the following features:
   a. LED(s), which shall flash to indicate communication with the Fire Alarm System, and which also illuminate in a steady manner when the detector is in an alarm status
   b. A means to allow field function testing of the detector
   c. A low-profile design / shape
   d. An insect screen
   e. Voltage and RF transient suppression techniques, in order to minimize false alarms

3. Smoke detectors shall communicate the actual smoke chamber values to the system control panel.

4. Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be logged and downloaded to a printer.

5. The detectors shall be plug-in units, which mount to a common base, and shall be UL 268 approved.

6. Each detector shall be compatible with the fire alarm panel and shall obtain its operating power from the SLC, to which it is connected. (Where relay or sounder-equipped bases are used, it shall be acceptable to require a separate 24 VDC or NAC connection.) Each detector shall be reset by actuating the control panel reset switch.

7. If field conditions so require the smoke detection devices shall not be installed until the construction is completed.

D. INTELLIGENT DETECTOR BASES

1. Bases shall be suitable for either smoke or heat detector mounting.

2. Either the base or the head shall contain electronic circuits that communicate the detector's status (normal, alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Contacts between the base and head shall be of the bifurcated type using spring-type, self-wiping contacts.

3. The base shall be lockable. The locking feature must be field-removable when not required.

4. Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.

5. The detector base shall be sealed against rear airflow entry.

6. Each detector's base or head shall contain LED(s), which shall flash when the detector is being scanned by the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.

E. INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

1. The detectors shall contain no radioactive material.

2. Detectors shall be of the solid state photoelectric type and shall operate on the light scattering photodiode principle using a pulsed infrared LED light.

F. INTELLIGENT THERMAL DETECTORS
1. The detectors shall be a combination rate-of-rise and fixed temperature 135 F unless noted.
2. Detectors shall sense within a temperature range of 32 F to 158 F. The control panel shall be capable of sensing either a set point of 135 F, or a rate-of-rise of 15 degrees F per minute for fire sensing.

G. INTELLIGENT DUCT SMOKE DETECTORS
1. Duct detectors shall be of the photoelectric type specified above. It shall be possible to alarm the duct detector by using a remote or local test switch.
2. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing's front cover.
3. Detector shall include remote keyed test switch and alarm LED indicator.
4. In mechanical rooms, alarm LED indicators for duct detectors shall be grouped on a stainless steel cover plate mounted adjacent to the main mechanical room door. Each LED shall be labeled with the detectors loop and address. A floor plan of the room showing the detectors and addresses shall be located adjacent to the cover plate. Provide Plexiglas cover over the plan.

H. ADDRESSABLE PULL STATIONS
1. Pull stations shall contain circuits that communicate the station's status (alarm, normal or trouble) to the control panel over two wires, which also provide power to the pull station. The address shall be field programmable on the station.
2. Manual stations shall be [single-action] [double-action] type, constructed of metal or of high impact, red Lexan with raised white lettering and a smooth high gloss finish.
3. Station shall mechanically latch upon operation and remain so until manually reset by means of a key common to all system locks. Stations that require Allen wrenches or special tools to reset them shall not be accepted.
4. Manual stations shall be fitted with screw terminals or wire leads for field wire attachment.
5. Manual pull stations shall be of the institutional key-operated type only. They shall be made of metal with tamper proof screws. Stations shall be labeled as "FIRE ALARM".

I. INTERFACE MODULES - GENERAL
1. If external power to Addressable Interface Modules is required, such power shall be 24VDC, and shall be derived from a supervised fire alarm power supply.
2. Addressable Interface Modules may be provided in either a Class B or Class A supervision version.
3. In the Class B version the wiring shall be supervised by an end-of-line device.
4. In the Class A version the wiring shall be looped back and connected to the module to allow continual operation of the controlled devices even if the wiring sustains a single break.
5. The interface modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions.

J. INTERFACE MODULES - SUPERVISED CONTROL
1. Supervised Control Modules shall be utilized where needed, for control of Notification Appliances.
2. For Notification Appliances, speakers, and other device control with Class B or Class A wiring supervision, the interface module shall provide a double-pole/double-throw relay output, with supervision.
3. These interface modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and shall receive from the fire alarm control panel a command to transfer the relay.

K. INTERFACE MODULES - SUPERVIS ED MONITORING
1. Addressable Monitor Modules shall be suited for monitoring of water-flow, valve tamper, Fire Suppression Control Panels, and other non-intelligent detectors and systems.
2. Addressable Monitor Modules shall be provided in any needed configuration, and may be used to interface any of the following initiation devices to a Signaling Line Circuit, as follows:
a. Conventional 2-wire smoke detectors, including providing suitable power to the IDC.
b. Normally Open, dry contact type devices - with class B or class A wiring supervision:
   ➢ These interface modules shall communicate the Initiating Device Circuit status (normal, alarm, trouble) to the control panel.

L. INTERFACE MODULES - NON-SUPERVISED CONTROL
1. This interface module shall provide double-pole/double-throw relay switching for loads up to 120VAC. It shall contain easily replaceable 2 amp fuses, one on each common leg of the relay.

2.07 CONVENTIONAL PERIPHERAL DEVICES

A. SPRINKLER WATERFLOW SWITCHES – WET SYSTEMS (EXISTING)
1. Waterflow switches shall be individually monitored, via individual IDCs, Monitor Modules, or Mini Monitor Modules. The point corresponding to each Waterflow switch shall be programmed such that when activated, the suitable Fire Alarm sequence shall be initiated.
2. If the flow switch incorporates an internal “cover tamper switch”, which actuates whenever the flow switch assembly cover is removed, the Trouble sequence shall be initiated in response to the removal of this cover.

B. SPRINKLER VALVE TAMPER SWITCHES – WET SYSTEMS (EXISTING)
1. Tamper switches shall be individually monitored by individual IDCs, Monitor Modules, or Mini Monitor Modules (Where two Valves, with Tamper Switches, are provided on both sides of a backflow preventer / double check valve assembly, such tamper switches may be monitored as a single point). The point corresponding to each Tamper Switch shall be programmed such that whenever the valve is partially closed, the Supervisory sequence shall be initiated.
2. If the tamper switch incorporates an internal “cover tamper switch”, which actuates whenever the flow switch assembly cover is removed, the Trouble sequence shall be initiated in response to the removal of this cover.

C. DOOR HOLDERS (IF REQUIRED)
1. Magnetic door holders shall have an approximate holding force of 25 lbs. (minimum) (recommended 35 lbs.)
2. The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing.
3. Unit shall be capable of being either surface, flush, or semi-flush mounted as required.
4. Power for 24 v dc door holders shall be independent and separate from the main power supply of the fire alarm panel.

2.08 AUDIO VISUAL NOTIFICATION APPLIANCES

A. HORNS
1. All horns shall be polarized, and shall be compatible with the 24 VDC NACs provided by the control panel and/or NAC Booster Panels/Supervised Control Modules. Each horn assembly shall include separate wire leads for in/out wiring for each leg of the associated signal circuit.
2. Horns shall be UL listed to provide a minimum sound pressure level of 93 dB at 10 feet, per UL Standard 464.]

B. STROBES
1. ALL strobes, and the strobe portion of audible/strobe combination units, shall be of the Xenon type.
2. All strobes shall be designed for synchronized flash operation at one flash per second (1 Hz) minimum over the device's listed input voltage range. Strobes shall be synchronized such that all strobe units within the building shall flash simultaneously
(As a minimum, all devices on each floor shall flash simultaneously, with flash timing within the limits established by current UL standards.).

2.09 SPECIAL DEVICES

A. TOOLS/KEYS
   1. Contractor shall provide two (2) keys per pull station. Keys shall be identical and usable in all keyways associated with this project – including, but not limited to Manual Pull Stations, the FACP, and FAAP Panel(s).

B. MANUFACTURER
   1. Notifier is the only accepted manufacturer for this project.

PART 3 - EXECUTION

3.01 GENERAL

A. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.
B. Smoke detectors shall not be mounted until the construction is completed, unless they are covered with plastic bags or fitted covers immediately after installation to maintain cleanliness.

3.02 RACEWAYS

A. NOTE: ALL EXPOSED AND CONCEALED FIRE ALARM SYSTEM WIRING SHALL BE INSTALLED WITHIN METALLIC CONDUIT.
B. All exposed wiring shall be in a conduit system separate from other building wiring. See Section 26 05 33 – Raceway and Boxes for Electrical Systems for specifications.
C. All wiring shall be in minimum ½" steel raceway.
D. 40% fill factor shall be applied to all conduit sizes.
E. The contractor shall size conduit and boxes by circular mil size of each cable in each conduit or box. The circular mil sizing can be found on the manufacturer’s spec sheet, then use the NEC codebook to make calculation to follow NEC Chapter 9 Tables and Annex C for box and conduit fill.
F. There shall be no sharp edges with installed materials.
G. Use only identified conduit entries or request approval for other penetrations in cabinets; (certain areas require clear space for interior components / batteries). Cabinet shall be grounded to either a cold-water pipe or grounding rod.
H. Existing conduit and surface metal raceway that is ½" in size or larger may be reused if found to have adequate space provided that it only serves the Fire Alarm system and doesn’t contain any AC wiring. All existing conduit that is reused MUST be brought up to the current State of Wisconsin Electrical Code and Approved for usage by the Engineer prior to work being done.

3.03 FREE AIR WIRING:

A. NOT ALLOWED.

3.04 CONDUCTORS:

A. All wire and cable associated with this system shall be as required by the equipment manufacturer. The following information is intended for estimating purposes only. However, the minimum wire gauges and colors specified shall be strictly adhered to. All cable shall be installed as per NEC Article 760.
B. All initiation and notification circuit cabling shall be listed Type FPL (300V) in accordance with NEC article 760."
C. All cables and wires #14 AWG and larger shall be stranded.
D. Fire alarm wiring shall be held in place at the device box, by means of a two-screw connector, (do not use squeeze or crimp type connectors).
E. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.
F. All conductors shall be color-coded. Coding shall be consistent throughout the facility. Green wire shall be used only for equipment ground.
G. Each Fire Alarm Control Panel, Annunciator Panel, shall be connected to separate dedicated branch circuit from the building panel, maximum 20 amperes. Circuit shall be labeled as “FIRE ALARM”. The breaker shall be painted red and cap-locked.
H. Power wiring for Fire Alarm Control Panel, Annunciator Panel, shall be #12 AWG.
I. Fire Alarm Control Panel, Annunciator Panel, shall have a green equipment ground wire.
J. Fire alarm risers, notification appliance circuits and interconnections to remote panels (per NFPA 72) shall have a minimum 2Hr fire alarm rating. All notification appliance circuits shall be protected from the fire alarm panel of origination to the signaling zone they serve.
K. Where fire alarm circuits enter or leave a building, additional transient 75 to 90 volt gas tube protection shall be provided for each conductor.
L. Leave 8-inch wire tails at each device box and 36-inch wire tails at the Fire Alarm Control Panel and Remote Annunciator Panel.
M. Cable for Intelligent detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket or per manufacturers recommendations installed in ½" conduit. Shield continuity must be maintained and connected to earth ground only at the control panel.
N. SLC wiring must not be in the same conduit with AC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B SLCs.
O. Cable for RS 232-c devices (CRT, PRINTER) shall be dual pair twisted-shielded.
P. Cable for RS 485 devices (Remote Annunciators) shall be twisted-shielded pair (Belden 9841 or equivalent) for the data signal. Power wiring shall be 12 AWG.
Q. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and labeled "FIRE ALARM SYSTEM" or "FA" by decal or other approved markings.
R. Speaker and strobe circuits shall have separate conductors, and shall operate independently of each other.
S. Speaker wiring shall be #18 AWG twisted-shielded cable or per manufacturers recommendations.
T. Strobe wiring shall be #14 AWG minimum.

3.05 DEVICE MOUNTING

A. GENERAL INFORMATION

1. Unless otherwise noted on the drawings, plans, specifications or by the Architect or Engineer; the recommended mounting heights, and requirements are as follows:

B. FIRE ALARM CONTROL PANELS

1. Mount control panels such that all visual indicators and controls are located at 60 inches above floor level.

C. ANNUNCIATOR PANELS

1. Mount FAAP panels such that all visual indicators and controls are located at 60 inches above floor level.

D. VISUAL AND AUDIO / VISUAL NOTIFICATION APPLIANCES

1. In Public-Mode Areas, as defined within NFPA-72, install flush, semi-flush or surface between 80 inches and 96 inches or 6 inches below finished ceiling or at 80 inches from the bottom of the device to the highest level of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches. If these requirements are not achievable, consult with the Engineer before installation.
2. Audio/visual devices may be installed on the ceilings only where indicated, or where approved in writing by the Engineer. (In such cases, these devices shall be installed in accordance with current NFPA 72 standards).
3. Except as noted in the previous paragraph, all audio/visual devices shall be installed at the same height throughout the facility.
4. For surface mounting, use manufacture-supplied back boxes and trim plates, which shall be painted Red or off White, and shall contain no visible conduit knock-outs. Mark each device with its circuit number.

E. MANUAL STATIONS
1. The operable part of the manual stations shall be installed not less than 3 ½ ft. (42") and not more than 4 ft. (48") above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address on the inside and outside of housing.
2. All manual pull stations shall be installed at the same height throughout the facility.
3. For surface mounting, use manufacture-supplied back boxes and trim plates. Back boxes shall be painted Red or off White, and shall contain no visible conduit knock-outs. Mark each device with its loop and address.
4. During the installation of the new fire alarm systems, new pull stations should be covered or identified as not being operable so building occupants will not be confused as to which fire alarm pull station should be pulled during an alarm condition. Likewise, after the new system is installed, tested and accepted, the existing pull stations should be identified as not being operable (or permanently removed as soon as possible).

F. HEAT AND SMOKE DETECTORS
1. The location of detectors shown on the plans is schematic only. The detectors must be located according to code requirements.
2. Surface mounted detectors shall be installed using back boxes equal to the base's size. Standard octagon and square boxes are not acceptable.
3. Detectors should be located on the highest part of a smooth ceiling so that the edge of the detector is no closer than 4 inches from a sidewall. Ceilings with beams, joists or soffits that exceed 8 inches in depth require special planning and closer spacing.
4. If it is necessary to mount a detector upon a sidewall, the top of the detector (the sensing chamber portion of the device) shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.
5. Smoke detectors should be installed to favor the air flow towards return openings and not located closer than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors shall be installed in direct airflow.
6. Duct smoke detector installation to be by this contractor and should be installed in the locations shown on the mechanical and electrical plans. Ensure that the duct smoke detectors are in serviceable locations. Consult with the mechanical designer for alternate locations if these are shown in non-serviceable locations. When locations on mechanical plans are not available, install in locations called for that provide accessibility for service. Do not install within four feet of a fan discharge.
7. Heat and smoke detectors should be located near the center of the open area which they are protecting, thus providing coverage generally for 15-foot radius for heat and smoke detectors. Questionable locations shall be verified with Architect or Engineer before installation takes place.
8. Heat and smoke detectors / Sensors – both Intelligent and non-addressable, shall be installed in accordance with their UL Listed Spacing. The quantity of Heat and smoke detectors / Sensors depicted on the drawings is based on the 900 square foot per detector rule. If detectors with significantly different spacing requirements are selected by the Fire Alarm equipment provider / EC, then additional detectors / sensors, if required, shall be provided at no additional cost to the project.

3.06 IDENTIFICATION

A. Attach the label containing the address and SLC designation to:
1. Each addressable detector. Label shall be visible and readable from the floor, 3/16” minimum character size (¼” is recommended).
2. Each manual pull station. Label shall be placed on the top part
3. Each Addressable Module. Label shall be attached to the faceplate
B. Label shall consist of black writing on white or clear background.
C. All junction boxes shall be painted red and labeled “Fire Alarm” or “FA”.
D. All circuits must be labeled with the name of circuit and the area being served by the circuit.
E. Wire/cable splices in junction boxes shall be labeled indicating where the wire/cable is coming from and where it is going.
F. All conductors terminated in control panels, annunciator panels and extension panels shall be labeled.
G. All audio visual devices shall be labeled by each circuit and the order of the device on that circuit such as “Circuit No. 2, strobe No. 05 of 10”.
H. All labels shall be permanent, and be machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED. Submit a sample for approval before using any labeling schemes.
I. Label size shall be appropriate for the conductor or cable size(s) and design. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the cable (sheath). Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
J. Adhesive type labels not permitted except for phase and wire identification.

3.07 TESTING

A. Before proceeding with any testing, all persons, facilities and building occupants whom receive alarms or trouble signals shall be notified by the contractor to prevent unnecessary response or building occupant distress. At the conclusion of testing, those previously notified shall be notified that testing has been concluded.
B. The manufacturer's authorized representative shall provide on-site supervision of installation of the complete fire alarm system installation, perform a complete functional test of the system, and submit a written report to the Contractor attesting to the proper operation of the completed system prior to final inspection.
C. Contractor shall pre-test each and every device in the system before the system is considered ready for final inspection.
D. The completed and pre-tested fire alarm system shall be fully tested in accordance with NFPA-72 by the Contractor in the presence of the Engineer, WTC representative, Owner's representative and the local Fire Department.
E. The Engineer or his authorized representative may suspend or discontinue the tests at any time performance is considered unsatisfactory. Resumption of testing will cover untested elements and any replaced elements. The contractor shall furnish all test personnel, test instruments and equipment of the accuracy necessary to perform the test. Arrangements for testing must be made with the WTC representative and the Engineer at least two weeks before the proposed testing date.
F. Upon the completion of a successful test, and prior to the final request for payment the Contractor shall:
1. Certify the system to the Owner in writing
2. Complete the NFPA 72 record of completion form
3. Provide as built and O&M manuals.
4. Provide a signed statement that the Owner had received the specified system operation and maintenance training
G. The final payment will not be processed unless these documents are complete and are on hand.
3.08 WARRANTY

A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of two (2) years from the date of substantial completion of the project.

B. At the end of the project, the Contractor shall post the warranty period along with the company’s name and telephone number inside the fire alarm panel.

C. Warranty service for the equipment shall be provided by the system supplier's factory trained representative. Further, Warranty shall include all parts, labor and necessary travel.

3.09 TRAINING

A. The Contractor through his/her supplier shall provide, as part of this contract, a minimum of (2) hours system operation training for owner, the Architect/Engineer, and fire department personnel.

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SECTION 31 10 00
SITE CLEARING

PART 1  GENERAL

1.01  WORK INCLUDED
A. The CONTRACTOR shall provide all materials, labor, equipment and service necessary, for the completion of the work specified in this section.
B. Remove hard-surface and fixed elements as per the construction documents.

Part 2  PRODUCTS – NOT USED

Part 3  EXECUTION

3.01  EXTENT OF WORK
A. Site preparation work shall be performed over all of the area lying within the project limit lines.

3.02  PROTECTION OF TREES
A. Existing trees which are to remain are to be protected against construction activity. Do not smother trees by storing materials within the canopy line. Wire plank protection shall be placed around the trunks.
B. If a tree scheduled to remain is destroyed by construction activity, the CONTRACTOR shall provide a tree of equivalent size and species or may be assessed a penalty not to exceed $2,000.00. Any such assessment will be deducted from the contract sum by Change Order.

3.03  DEMOLITION
A. Conduct demolition work with minimum interference to roads, streets, driveways, sidewalks, and other facilities including adjacent buildings, structures and their occupants.
B. Sawcut all hard surfaces to provide a clear break line for new abutting surfaces to join at all locations indicated on the construction documents.
C. Remove all fixed elements as indicated on the construction drawings.
D. Take precautions to guard against movement, settlement or collapse of any surrounding structures indicated to remain and be liable for any such movement, settlement or collapse.

3.04  SALVAGE MATERIALS
A. Verify with the PROJECT CIVIL ENGINEER, prior to the start of demolition all existing items which will be salvaged and turned over to the OWNER for future use.
B. Remove all items indicated on the construction documents to be salvaged so as to prevent damage during construction activity.
C. Place all salvaged items on site at a secure location determined by the OWNER for their future use. or reinstallation if required as part of this bid package

3.05  DISPOSAL OF WASTE MATERIAL
A. Burning is not permitted on the OWNER’S property, unless authorization is obtained from the OWNER and the local governing Fire Department.
B. Remove all organic and cleared vegetative matter from the site and dispose of in a legal manner.
C. Remove all concrete, bituminous and debris from site and dispose of in a legal manner.

END OF SECTION
SECTION 31 14 13

SALVAGE TOPSOIL

PART 1 GENERAL

1.01 SECTION INCLUDES
A. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for the completion of the work specified in this section.
B. Spread salvaged topsoil material to proposed finished grades.

PART 2 PRODUCTS

2.01 SALVAGED TOPSOIL
A. Natural loam, sandy loam, silt loam, silty clay loam or clay loam humus-bearing soils stripped from areas within the project limits.

PART 3 EXECUTION

3.01 SPREADING TOPSOIL
A. Remove stones and rocks larger than 1", roots, grass, weeds, debris and other foreign material from salvaged topsoil prior to placement.
B. Place topsoil in relatively dry conditions.
C. Finish grade topsoil removing rough and low areas to insure positive drainage. Maintain grades, elevations and contours of subgrade. Proposed finished topsoil grade shall not vary more than 1/4" from required elevation in 10’ measured in any direction.
D. Manually spread salvaged topsoil around trees, plants and buildings to prevent damage which may be caused by grading equipment.
E. Slightly compact topsoil after placement.
F. Excess topsoil shall be removed from the site in a legal manner, unless otherwise directed by the OWNER. Maintain erosion control measure as required to prevent erosion and runoff.

END OF SECTION
PART 1 GENERAL
1.01 WORK INCLUDED
   A. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for the completion of the work specified in this section.
   B. Salvaging Topsoil
   C. Unclassified Excavation
   D. Excavating, Backfilling, and Compacting for Structure
   E. Excavating, Backfilling, and Compacting for Utilities
   F. Excavating, Backfilling, and Compacting for Pavement
   G. Topsoil Placement
   H. Landscape Finish Grading
   I. Bio-Retention Basin

1.02 REFERENCES

1.03 EXISTING CONDITIONS
   A. Known underground, surface, and aerial utility lines and buried objects are indicated on the drawings. Contact Digger's Hotline and the OWNER five (5) working days prior to start of demolition and construction.
   B. Locate all private utilities; coordinate with OWNER five (5) working days prior to the start of work.
   C. Hand expose existing utilities prior to start of work.

1.04 SUBMITTALS
   A. Samples: Submit 25 lb sample of each type of fill to testing laboratory, in air-tight containers.

1.05 RECORD DOCUMENTS
   A. Accurately record locations of utilities remaining, by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS
2.01 MATERIALS
   A. Topsoil: On site excavated material, graded, free of roots, rocks larger than 1", subsoil, debris, and large weeds.
   B. Subgrade: Excavated material, graded, free of clumps larger than 6", rocks larger than 3", and debris.
   C. Breaker Run: Breaker Run material, when required, shall meet the requirements of Section 311 of the current edition of the Standard Specifications for Highway and Structure
Construction. Substitutes or variation of these recommendations shall require approval by the project ARCHITECT.

D. Stone Bedding: Stone for Class “B” bedding shall meet requirements of ASTM 33.0 with P200 content not exceeding 5%.

E. Dense Graded Base Course: Dense graded base course shall meet the requirements of Section 305, Dense Graded Base course of Standard Specifications for Highway and Structure Construction for D.O.T. 1-1/4” Gradation.

F. Medium Rip Rap: Medium rip rap shall meet the requirements of Section 606 of the current edition of the Standard Specifications for Highway and Structure Construction. Substitutes or variation of these recommendations shall require approval by the project ARCHITECT.

2.02 MATERIALS

A. Surface Mulch Layer: Shredded hardwood mulch or chips, aged a minimum of twelve months, shall be placed on the surface of the bioretention area. The mulch shall be free of foreign material including other plant material.

B. Engineered Soil:
   - The sand shall meet one of the following gradation requirements:
     - USDA Coarse Sand (.02 - .04 inches)
     - ASTM C33 (Fine Aggregate Concrete Sand)
     - Wisconsin Standards and Specifications for Highway and Structure Construction, Section 501.2.5.3.4. (Fine Aggregate Concrete Sand) current edition, or an equivalent as approved by the administering authority.
   - The compost shall meet the requirements of S100 in the Wisconsin DNR Runoff Management Storm Water Technical Standards.
   - The sand component shall consist of mineral sand that is at least 97% SiO2. Substitutions, such as calcium carbonated sand, dolomitic sand, manufactured sand, or stone dust are not allowed. The sand shall be washed to removed clay and silt particles, and well-drained prior to mixing.
   - The engineered soil mix shall be free of rocks, stumps, roots, brush, or other material over 1 inch in diameter. No other material shall be mixed with the planting soil that may be harmful to plant growth to prove a hindrance to planting or maintenance. The engineered soil mix shall have a pH between 5.5 and 6.5.
   - The engineered soil mix shall have adequate nutrient content to meet plant growth requirements.

C. Sand Storage Layer: A layer of sand may be used in lieu of gravel to form the storage layer. The sand shall meet the specification identified above.

PART 3 EXECUTION

3.01 SALVAGING AND SPREADING TOPSOIL

A. Remove materials of horticultural value from topsoil prior to stripping.
B. Disc existing turf 8" deep two directions prior to stripping topsoil material.
C. Strip topsoil; do not allow topsoil to be mixed with subgrade.
D. Stockpile salvaged topsoil on site for future use.
E. Place silt fence around the base of the topsoil stockpile to audio sediment runoff.

3.02 UNCLASSIFIED EXCAVATION

A. Excavating
1. Excavate in accordance with design grades and elevations.
2. Do not perform additional excavation without prior written authorization of A/E/OWNER.
4. Hand trim excavations to remove loose and/or organic matter.
5. Fill over-excavated areas under structure bearing surfaces with stone bedding.
6. Do not disturb soil within canopy line of existing trees or shrubs that are to remain.
7. If necessary to excavate through canopy line, perform work by hand and cut roots encountered with a sharp ax.

B. Overhaul
1. Haul excess material from site and dispose of in a legal manner.

C. Granular Fill
1. Place fill materials in lifts not exceeding 9” in depth in accordance with design grades and contours.

D. Rough Grading
1. Rough grade site to required contours and elevations as required for finish grading and surface treatment.

3.03 EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURE
A. Excavate to indicated elevations and dimensions within a tolerance of ±1”. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Perform all structure excavation in accordance with the Subsurface Soil Investigation Report and as recommended by the GEOTECHNICAL ENGINEER.

3.04 EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES
A. Preparation
   1. Establish limits of excavation by area and elevation. Designate and identify datum elevation.
   2. Set required lines and levels.
   3. Maintain existing and established benchmarks, monuments, and other reference points.

B. Utilities
   1. Notify utility companies to adjust, relocate, and/or remove lines which are in the way of excavation.
   2. CONTRACTOR shall be responsible for maintaining, adjusting, or relocating existing utility lines which are located in the work area. Costs exceeding those covered by utility companies shall be included in CONTRACTOR’S bid.
   3. Protect and maintain active utility services exposed by excavation.
   4. Remove abandoned utility lines from areas of excavation. Cap, plug, or seal such lines and notify project A/E of such work completed.
   5. Locate and record abandoned and/or active utility lines adjusted or relocated during construction with the project A/E.
6. Gas, electric (including main service, site lighting, conduits, and signage) cable, and telephone construction by others. Coordinate all earthwork activities with respective trades responsible for installation of said utilities.

C. Excavation
   1. Excavate in accordance with lines and grades indicated on the plan set documents.
   2. Excavate trenches wide enough to enable proper installation of utilities and to allow for inspection. Trim and shape trench bottoms and leave free of irregular lumps and projections.
   3. Do not disturb soil within canopy line of existing trees or shrubs that are indicated to remain. If it is necessary to excavate within the canopy line, perform work by hand and cut exposed roots with a sharp ax.
   4. When complete with work, request CONSTRUCTION MANAGER to inspect excavations. Correct unauthorized excavation as instructed by A/E at no additional cost to OWNER.
   5. Stockpile excavated subsoil material for reuse on site. Remove excess or unsuitable excavated subsoil material from site and dispose of it in a legal manner.

D. Dewatering Trenches
   1. Provide equipment including pumps, piping, and temporary drains required to keep trenches dry during construction.
   2. Do not discharge pumped water directly into municipal sewer systems without receiving prior approval. Ensure discharge water does not contain contamination or silt held in suspension.
   3. Direct surface drainage away from excavated areas. Control grading in and adjacent to excavations to prevent water running into excavated areas or onto adjacent properties or public thoroughfares.
   4. Furnish and operate pumping equipment on a twenty-four (24) hour basis if needed to keep excavated areas free of water until utilities have been placed and backfilled.

E. Backfilling
   1. All backfill material shall be on-site material unless granular fill is required by A/E/OWNER.
   2. Do not start backfilling until utilities have been inspected by project A/E.
   3. Ensure trenches are not in a frozen condition and are free of debris, snow, ice, or water.
   4. Backfill as early as possible to provide time for natural settlement and compaction.
   5. Place and compact backfill materials in lifts not exceeding 12". Use methods so as not to damage or disturb utilities.
   6. Maintain optimum moisture content of backfill materials so as to attain required compaction density.
   7. Remove excess backfill materials from site.

3.05 EXCAVATING, BACKFILLING, AND COMPACTING FOR PAVEMENT

A. Excavation
   1. Excavate the subsoil in accordance with grades and elevation required for completion of the work.

B. Backfilling
   1. Verify areas to be backfilled are not frozen and are free from debris, snow, ice, and water.
   2. Do not backfill over existing subgrade materials which are wet or spongy.
   3. Compact existing subgrade materials if densities are not equal to that specified for backfill materials
4. Cut out soft, wet, or spongy areas of existing subgrade. Backfill with specified granular fill material and compact to required density.
5. Backfill as early as possible to provide time for natural settlement and compaction to occur.
6. Provide water if needed to maintain optimum moisture content of backfill materials to meet specified compaction density.
7. If dewatering is required it will be incidental to the excavation.

C. Excavation Below Bituminous Paved Areas Subgrade
1. Deposits of frost-susceptible material, silty soils, water-bearing soil, topsoil containing considerable amounts of vegetable matter, or other unsuitable material shall be removed from the area to receive paved surfaces to such depths below the proposed finish grade shown on the plans or as direction by the A/E. The bottoms of such excavations shall be sloped and graded so that water does not pond in the bottoms of excavated areas.
2. Humus-bearing soils and other excavated materials not suitable for embankment construction shall be disposed of off-site in a legal manner.
3. Over excavation of unsuitable material shall be deemed as an extra. See the Bid Form.
4. Backfill required for over-excavation shall be granular fill and deemed as an extra.

3.06 TOPSOIL PLACEMENT AS FINISH GRADING
A. Place topsoil in areas where seeding and/or sodding is required to a thickness of 6” lightly compacted depth.
B. Place topsoil in relatively dry state, during dry weather.
C. Finish grade topsoil eliminating rough or low areas while maintaining profiles and contour of subgrade and achieving required 6” compacted depth.
D. Remove roots, debris, rocks larger than ½” in size, weeds, and foreign material while spreading.
E. Manually spread topsoil close to trees, fences, buildings, and other objects to prevent damage.
F. Lightly compact topsoil after placement.
G. Leave the stockpile area and site clean and ready for seeding, sodding, or other finish treatment.

3.07 PROTECTION
A. Protect existing features remaining as part of final landscaping.
B. Protect existing and established benchmarks, roads, sidewalks, paving, vegetation, and curbs against damage from equipment and vehicular or foot traffic.
C. Protect excavation areas by shoring, bracing, sheet piling, underpinning, or other methods as needed to prevent cave-ins or loose dirt from falling into excavations.
D. Secure adjacent structures prior to the start of excavation which may be damaged by excavation work, including utility lines and pipe chases.
E. Notify A/E of unforeseen subsurface conditions encountered and discontinue work in the area until A/E provides notification to resume work.
F. Grade around excavation areas to prevent surface water runoff into excavated areas resulting in pounding.

3.08 COMPACTION REQUIREMENTS
A. Compact all subgrade of proposed bituminous pavement areas to ASTM D1557, 95% Modified Proctor.
B. Compact all turf areas to ASTM D1557, 85% Modified Proctor.
C. The CONTRACTOR shall provide equipment capable of adding measured amounts of moisture to the soil material as determined by moisture-density tests. Where the subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply required amount of water to the surface of subgrade, or layer of soil material in such manner as to prevent free water from appearing on the surface during or subsequent to compaction operations. Remove and replace soil material that is too wet to permit compaction to 95% of maximum dry density, as established in accordance with ASTM-D1557.

D. Place acceptable granular fill material in lifts no greater than 9" loose thickness.

3.09 COMPACTION TESTING

A. Testing of compacted materials will be performed by an independent testing laboratory appointed and paid for by the CONTRACTOR. The CONTRACTOR shall pay for any additional testing costs as required due to improper performance of work.

B. The CONTRACTOR shall pay for the cost of one series of tests for the area being evaluated. The CONTRACTOR shall also pay for any additional testing costs as required due to improper performance of work.

C. When work for this section or portions of work are completed, notify the testing laboratory to perform density tests. Do not continue with additional portions of work until test results have been verified.

D. If, during progress of work, tests indicate that compacted backfill materials do not meet specified requirements, remove defective work, replace and retest at no cost to OWNER as directed by the A/E.

E. Verify that compacted fills have been tested before proceeding with placement of surface materials.

F. In-field testing shall be in accordance with ASTM D2922-78 “Density of Soil and Soil-Aggregate in Place by Nuclear Method.” This test correlates to D-1556-74 “Density of Soil in Place by the Sand-Cone Method.”

G. The CONTRACTOR shall notify the testing laboratory and the A/E a minimum of forty-eight (48) hours in advance of the time compaction testing is required.

3.10 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10’.

3.11 FIELD QUALITY CONTROL

A. Testing of granular fill and backfill materials will be performed by an independent testing laboratory appointed and paid for by the CONTRACTOR. The CONTRACTOR will pay for costs of additional testing required due to improperly performed work.

C. Tests and analysis of fill material shall be performed in accordance with ANSI/ASTM D698 D1557.

D. Compaction testing shall be performed in accordance with ANSI/ASTM D1556, ANSI/ASTM D1557, ANSI/ASTM D698.

D. If testing indicates that the work does not meet specified requirements, remove work, replace and retest at no cost to OWNER.

3.12 BIO-RETENTION BASIN

A. Construct the Bio-Infiltration Basin in accordance with the Wisconsin Department of Natural Resources, Runoff Management Storm Water Technical Standards, 1004.

B. Ensure surrounding drainage areas have been fully stabilized before installing engineered soil in bioretention basin.

C. Immediately after installing engineered soil place silt fence around bio-retention basin until all disturbed areas are stabilized.
D. Inspection by Point of Beginning is required during the construction of the Bio-retention. Please contact Dan St. Pierre at 715-344-9999 at least 48 hours prior to construction of the bio-retention basin.

E. If dewatering is required it will be incidental to the construction of the bio-retention basin.

END OF SECTION
SECTION 31 25 00
EROSION CONTROL

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for the completion of the work specified in this section.
   B. Placement and removal of silt fence.
   C. Placement of erosion control blankets/turf reinforcement.
   D. Installation of sediment tracking construction entrance.
   E. Installation of riprap
   F. Placement, cleaning, and removal of inlet protection.

1.02  RELATED SECTIONS
   A. Section 311000 – Site Clearing
   B. Section 312000 – Earthmoving
   C. Section 334100 – Storm Utility Drainage Piping

1.03  REFERENCES
   B. Wisconsin Department of Natural Resources Storm Water Construction and Post-Construction Technical Standards.
   C. State of Wisconsin Department of Transportation, Erosion Control Product Acceptability List for Multi-Modal Applications (PAL), Current Edition

1.04  REQUIREMENTS
   A. CONTRACTOR shall provide and secure all erosion control permits from all governing authorities not previously obtained by the OWNER.
   B. The OWNER shall obtain the WDNRWPDES Notice of Intent: The CONTRACTOR shall abide by the requirements set in the Notice of Intent (NOI). A copy may be acquired from the ARCHITECT.
   C. Erosion control measures shall be installed as indicated on the project construction documents and abiding with requirements of the Wisconsin Storm Water Construction and Post-Construction Technical Standards.
   D. Including but not limited to the WDNR/ WPDES Notice of Intent (N.O.I.).

PART 2  PRODUCTS
2.01  EROSION CONTROL BLANKETS
   A. Erosion control blankets for non-channel use shall meet the requirements in Standard 1052 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.
   B. Erosion control blankets for non-channel use shall be on the Wisconsin Department of Transportation’s PAL for Class I Erosion Mats, Type A.
   C. Erosion control blankets for use in channels shall be on the Wisconsin Department of Transportation’s PAL for Class III, Type B Turf Reinforcement.

2.02  SILT FENCE
   A. Silt Fence shall meet the requirements in Standard 1056 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.
2.03 SEDIMENT TRACKING CONSTRUCTION ENTRANCE
A. Sediment tracking construction entrance shall meet the requirements in Standard 1057 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.

2.04 RIPRAP
A. Riprap shall meet the requirements for light riprap in Section 606.2 of the Standard Specifications for Highway and Structure Construction. Material shall be granit and approved by owner prior to placement.
B. Geotextile fabric beneath riprap shall meet the requirements of geotextile fabric type HR in Section 645.2 of the Standard Specifications for Highway and Structure Construction.

2.05 INLET PROTECTION
A. Inlet Protection shall meet the requirements in Standard 1060 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.
B. Inlet Protection shall have Wisconsin Department of Transportation PAL Type FF, geotextile fabric.

PART 3 EXECUTION
3.01 INSTALLATION OF EROSION CONTROL BLANKET
A. Install Erosion Control blanket in accordance with Standard 1052 and 1053 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.
B. Refer to manufacturer’s recommendations and detail drawings for additional installation information.

3.02 INSTALLATION OF SILT FENCE
A. Install silt fence in accordance with Standard 1056 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.

3.03 SEDIMENT TRACKING CONSTRUCTION ENTRANCE
A. Install sediment tracking construction entrance in accordance with Standard 1057 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.

3.04 RIPRAP
A. Install geotextile fabric and riprap in accordance with Sections 645.3 and 606.3 of the Standard Specifications for Highway and Structure Construction.

3.05 INLET PROTECTION
A. Install inlet protection in accordance with Standard 1060 in the Wisconsin Storm Water Construction and Post-Construction Technical Standards.

END OF SECTION
SECTION 32 11 13
DENSE GRADED BASE

Part 1 GENERAL

1.01 WORK INCLUDED
   A. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for the completion of the work specified in this section.
   B. Furnish, place and compact dense graded base course for pavement areas as indicated on construction documents.

1.02 REFERENCES
   A. ASTM D26938– Density of Soil and Soil-Aggregate in Place by Nuclear Method.

Part 2 PRODUCTS

2.01 DENSE GRADED BASE COURSE
   A. Dense graded base course shall meet Section 305, D.O.T. 1-1/4” Gradation Dense Graded Base Course of Standard Specifications for Highway and Structure Construction.
      a. No recycled/reclaimed material may be used.

Part 3 EXECUTION

3.01 GENERAL
   A. Place material meeting requirements of Section 305 of Standard Specifications for Highway and Structure Construction, Current Edition, State of Wisconsin Department of Transportation, Division of Highways.
   B. Compact base course to at least 95% of the maximum Modified Proctor dry density (ASTM D1557)
   C. Remove surplus material from site and dispose of in a legal manner.
   D. Contractor is responsible for maintaining base course in a suitable condition for paving.

3.02 FIELD QUALITY CONTROL
   A. Testing of aggregate base will be performed by an independent testing laboratory appointed and paid for by the Owner. The Contractor will pay for costs of additional testing required due to improperly performed work. All test reports shall be provided to Owner.
   B. If testing indicates, the work does not meet specified requirements, remove work, replace aggregate, and retest at no cost to Owner.
   C. Field Tests and Inspections:
      1. Miscellaneous exterior concrete areas:
         A. Testing Agency shall provide testing and inspection for exterior aggregate base.
         B. Number of tests may vary at discretion of Architect.
C. Testing Agency will test compaction of base in place according to ASTM D1556, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
   a) Site work Areas: One test for every 10,000 sq. ft. or less of exterior pads area but no fewer than three tests.

2. Asphalt paving area:
   A. Testing Agency shall provide testing and inspection for exterior aggregate base.
   B. Number of tests may vary at discretion of Architect.
   C. Testing Agency will test compaction of base in place according to ASTM D1556, ASTM D1557, and ASTM D6938, as applicable. Tests will be performed at following frequency:
   D. Site work Areas: One test for every 10,000 sq. ft. or less of exterior pads area but no fewer than three tests.

END OF SECTION
SECTION 32 12 16
ASPHALT PAVING

Part 1  GENERAL
1.01  WORK INCLUDED
   A. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for the completion of the work specified in this section.
   B. Finish grading of dense graded base.
   C. Proof rolling of dense graded base.
   D. Asphalt pavement for all proposed paved areas indicated on drawings.

1.02  REFERENCES

1.03  QUALITY ASSURANCES
   A. Job Mix
      1. Prior to starting work, the CONTRACTOR shall submit to the project Civil Engineer a Job Mix Formula which has been prepared by a credible and independent testing laboratory. The CONTRACTOR, if required, shall submit separate job mixes for the surface and binder courses. The formula shall be based on testing of the material actually intended for use on the project. The report shall be based on the Marshall Stability Method of Mix Design (ASTM D1559) and shall indicate the proposed mix meets the requirements in Section 460.2 of the Standard Specifications for Highway and Structure Construction for the specified mix.
      2. No work shall start until receipt of project Civil Engineer approval of the formula.
      3. The project Civil Engineer will inspect the paving operation, monitoring construction methods, gradation, temperature and finished density. Paving mix shall be monitored for proper gradation to ensure stability, flow and air voids is produced, and is maintained. It shall be the responsibility of the CONTRACTOR to ensure that the mix meets the specified and submitted formula. The CONTRACTOR shall provide samples of aggregate and asphalt on request for purposes of testing or patching density core removals. If the owner elects to have testing done, the cost of testing for this portion shall be covered by OWNER, unless otherwise specified.
      4. All construction procedures and materials noted by Civil Engineer not in accordance with this specification shall be discontinued or made to conform.

Part 2  PRODUCTS
2.01  ASPHALTIC PAVEMENT
   A. Asphaltic pavement shall meet the requirements of HMA Pavement 3 MT 58-28 S and 4 MT 58-28 S, Section 460.2.1 to 460.2.7 of the Standard Specifications for Highway and Structure Construction.
   B. Asphaltic pavement aggregate gradation shall conform to the 12.5 mm and 19.0 mm aggregate gradation master ranges in Table 460-1 of the Standard Specifications for Highway and Structure Construction.
   C. Asphaltic binder grade shall be PG 58-28 S.
   D. The project Civil Engineer reserves the right to alter the grade of asphalt at the time of construction other than that specified in the contract, based on existing conditions.
Part 3 EXECUTION

3.01 PREPARATION OF DENSE GRADED BASE
   A. Finish grade dense graded base.
   B. Proof roll dense graded base with fully-loaded tandem-axle dump truck in front of geotechnical engineer or experienced soils technician, just prior to paving operations. Areas of poor performance shall have soft soils removed and corrected.
   C. Dense graded base shall be finish graded smooth and trimmed. It shall not vary more than 1/4” in any direction within 10’ from required line, grade and level. It is the CONTRACTOR’S responsibility to maintain it in this condition until placement of asphaltic concrete.
   D. Base course shall be watered and rolled immediately prior to placement of asphaltic concrete.

3.02 INSTALLATION OF ASPHALTIC PAVEMENT
   A. Asphaltic concrete paving shall conform to Section 465.3 Standard Specifications for Highway and Structure Construction, current edition, unless specifically mentioned otherwise.

3.03 TOLERANCES
   A. Finish grade shall not vary from required line, grade and level in 10’ measured in any direction by the following:
      1. Base Course: 1/4”
      2. Drives and parking areas: 1/8”

3.04 FIELD QUALITY CONTROL
   A. Testing of asphalt paving will be performed by an independent testing laboratory appointed and paid for by the Owner. The Contractor will pay for costs of additional testing required due to improperly performed work. All test reports shall be provided to the Project Engineer.
   B. Independent testing agency shall provide nuclear density testing in accordance with ASTM D2950/D2950M-10 during asphalt paving operations.
   C. Provide written nuclear density testing of asphalt paving at a minimum rate of one test per 10,000 sq. ft. (minimum of 5 tests required). Select test locations by ASTM D3665 and sample per ASTM D979.
   D. If testing indicates the work does not meet specified requirements, remove and replace non-conforming asphalt at no additional cost to Owner.

END OF SECTION
SECTION 32 13 13
PORTLAND CEMENT CONCRETE PAVING

PART 1  GENERAL

1.01  WORK INCLUDED
A. Exterior concrete for:
   1. Paving/Slabs
   2. Concrete sidewalks
B. Surface finish.
C. Curing.

1.02  RELATED WORK
A. Section 32 11 23 – Aggregate Base Course.

1.03  QUALITY ASSURANCE
A. Perform work in accordance with ACI 301.
B. Obtain materials from same source throughout.
C. Regulatory Requirements:
   1. Construct ramps and curb ramps in accordance with Americans with Disabilities Act.

1.04  SUBMITTALS
A. Submittals:
   1. Proposed Mix Design for review prior to commencement of work.
   2. Product Data: Manufacturer’s specifications and installation instructions for Detectable Warnings for Curb Ramps.

1.05  TESTS
A. Submit proposed mix design for review prior to commencement of work.
B. Test Reports: Reports in accordance with requirements specified in Article D, Field Quality Control.

PART 2  PRODUCTS

2.01  CONCRETE MATERIALS
B. Normal Weight Aggregates: Conforming to ASTM C 33 “Standard Specification for Concrete Aggregate.” Aggregates not complying with this standard may be used providing it can be shown by special test or a record of past performance that these aggregates produce concrete of adequate strength and durability.
C. Fine aggregate: clean, natural sand, free from loam, clay lumps or deleterious substances. Fineness modulus of sand shall have a minimum value of 2.3 and a maximum value of 3.0.
D. Coarse aggregate:
   1. Crushed and graded limestone containing no clay, mud, loam or foreign matter.
2. Limit to 1% of the coarse aggregate by weight the amount of chert with a specific gravity less than 2.40 in exposed concrete.

3. Coarse aggregate shall be nominal maximum sizes of 3/4", conforming to ASTM C33, Table 2.

E. Water: shall be clean and free from deleterious materials.

F. Curing Compounds: Conforming to ASTM C-309, Type 1, Class A, clear or translucent without fugitive dye; Wax or saponifiable resin types are not approved.
   1. Curing compounds shall exceed the moisture retention requirements of ASTM C309, when tested in accordance with ASTM C156 at the maximum coverage rate recommended by the manufacturer.
   2. Approved Products:
      a. "Masterseal" by Master Builders
      b. "1100 Clear" by W.R. Meadows
      c. "Tri-Kote 26" by T. K. Products

G. Concrete Sealant: Conforming to AASHTO T-260-78, Chloride Penetration.
   1. Approved Products:
      a. "TK-TRI-SILANE 590-100" by T.K. Products

2.02 DESIGN

A. Provide concrete mix with the following properties:
   1. Compressive Strength: 4,000 psi at 28 days
   2. Slump: 2" to 4"
   3. Maximum water to cementitious material (cement plus fly ash) ratio: 0.45.
   4. Minimum cement plus fly ash content: 520 lbs. per cubic yard
   5. Total air content required (air-entrained and entrapped air): 6% +/- 1.5%.

2.03 ACCESSORIES

A. Preformed Joint Filler: ASTM D1751, asphalt impregnated fiber board. Provide filler throughout the slab depth and of 1/2" thickness.

B. Detectable Warnings for Curb Ramps: Mat with truncated domes complying with Americans with Disabilities Act; provide fasteners and adhesives as recommended by mat manufacturer.
   1. Recycled Tire Core: Nylon and Rayon fibers mixed into rubber composite.
   2. Slip resistant surface.
   3. Perimeter beveled-edge.
   4. Provide fasteners, sealers, and adhesives as recommended by mat manufacturer:

PART 3 EXECUTION

3.01 GENERAL

A. Place material meeting requirements of Section 305 of Standard Specifications for Highway and Structure Construction, 2019 Edition, State of Wisconsin Department of Transportation, Division of Highways.

B. Compact material meeting Special Compaction Requirements of Section 305 of Standard Specifications for Highway and Structure Construction, 2019 Edition, State of Wisconsin Department of Transportation, Division of Highways.
C. Remove surplus material from site and dispose of in a legal manner.

3.01 INSPECTION
A. Verify compacted granular base is ready to support paving and imposed loads.
B. Verify gradients and elevations of base are correct.
C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION
A. Moisten base to minimize absorption of water from fresh concrete.
B. Notify ARCHITECT a minimum 24 hours prior to commencement of concreting operations.

3.03 FORMING
A. Place and secure forms to correct location, dimension, and profile.
B. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

3.04 FORMED JOINTS
A. Place expansion joints in sidewalks every 400 square feet with a maximum 80 ft. o.c. spacing.
B. Place expansion joints in curb and gutter at 100 ft. o.c.
C. Place expansion joints between curbs and walks.
D. Place joint filler in expansion joints and between curbs and walks, between paving components and building, and at catch basins, manholes, and other appurtenances. Recess top of filler 1/2 inches for sealant placement.
E. Provide scored or sawn control joints. Joints shall be at right angles to the edges of work.
   1. Where walks are wider than 8'-0" provide longitudinal joints as directed.
   2. Space control joints per plan or if not stated at 6-foot intervals for sidewalks.
   3. Space control joints at 10 feet intervals for curbs.
   4. Place control joints in flat work every 100 square feet with maximum 10 ft. spacing.
   5. All panels should be square or nearly so. The length should not exceed 1.5 times the width.
F. Place construction joints at the end of all pours and at locations where placement operations are stopped for more than 1/2 hour. If the construction joint will also be an expansion joint, dowel and sleeve the reinforcement.

3.06 PLACING CONCRETE
A. Place concrete in accordance with ACI 301.
B. Tolerances
   1. Finish grade shall not vary from required line, grade and level in 10' measured in any direction from required line, grade, and level by the following:
      a. Concrete walks/curbs: 1/4"
   2. If the concrete surface varies more than the allowed tolerance, it will be at the discretion of the CIVIL ENGINEER whether the concrete section shall be removed and replaced.

3.07 FINISHING
A. After striking off and consolidating concrete, smooth the surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compact the surface and produce a uniform texture.
B. Provide positive slope on concrete surfaces to provide drainage.
C. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous, smooth finish.

D. Work edges of walks and joints with a 1/4" radius edging tool, and a 4" wide smooth troweled surface at edges; provide broom finish on remainder of surface.

E. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing by drawing a fine-hair broom across the concrete surface, perpendicular to the line of traffic. Repeat operation if required to provide a fine line texture acceptable to the A/E.

F. Install Detectable Warning Mats at Curb Ramps in accordance with manufacturer's instructions:
   1. Surface must be completely dry with no precipitation at least 24 hours prior to installation.
   2. Surfaces with newly poured concrete must be fully cured.
   3. Place the mat in position on the installation surface and adjust fit.
   4. Install mat with recommended Adhesive and Anchors.
   5. Seal Edges of mat with recommended Sealer.

3.08 CURING/PROTECTION

A. Use curing methods and provide protection as required.

B. Apply Curing Compound uniformly in continuous operation by power-spray or roller in accordance with manufacturer's instructions.
   1. Recoat areas subjected to heavy rainfall occurring within 3 hours after initial application.
   2. Maintain continuity of coating and repair damage during curing period.

C. Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, and mechanical injury.

D. Exclude traffic from concrete for at least 14 days after placement. When construction traffic is permitted, maintain the work as clean as possible and remove surface stains and spillage of materials as stains and spillages occur.

3.09 FIELD QUALITY CONTROL

A. Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not prevent rejection when defect is discovered, nor shall it obligate the owner for final acceptance.

B. Testing agencies shall meet the requirements of "Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction", ASTM E 329.

C. The following testing services shall be performed by the testing agency and shall be paid for by the Owner. Any additional testing due to failing results will be paid for by the Contractor.
   2. Mold and cure four cylinders from each test required in accordance with "Standard Method of Making the Curing Concrete Test Specimens in the Field," ASTM C 31.
3. Test cylinders in accordance with "Cylindrical Standard Test Method for Compressive Strength of Concrete Specimens," ASTM C 39. Two cylinders shall be tested at 28 days for acceptance and one shall be tested at 7 days and one at 14 days for information.

4. Make one set of cylinders for each 50 cubic yard or 5000 square feet of wall or floor surface or fraction thereof, of each mix design of concrete placed in any one day.

5. A record shall be made by a representative of the General Contractor of the delivery ticket number for the particular load of concrete tested and the approximate location in the work at which each load represented by a strength test is deposited.


7. Submit one copy of all test data to A/E and the CONCRETE SUPPLIER within 3 days of tests.

END OF SECTION
SECTION 32 17 23
PAVEMENT MARKINGS

Part 1  GENERAL
1.01  SCOPE OF WORK
   A. The CONTRACTOR shall provide all labor, materials, equipment and service
      necessary, or incidental, to the completion of the work specified in this section.
   B. Parking lot striping.

1.02  QUALITY ASSURANCE
   A. Work in this section shall be completed by workmen skilled and experienced in the
      application of pavement markings on bituminous surfaces. Submit to the
      project Civil Engineer evidence of five (5) years of experience. List projects
      of a similar scope.

1.03  JOB CONDITIONS
   A. Verify with the asphaltic paving contractor that the surface on which the markings are
      to be applied has cured and is ready to be striped.
   B. Observe the environmental precautions regarding temperature and humidity in the
      application of the line marking paint. Delay applications when drying conditions will
      not allow the paint materials to dry in a timely manner.

Part 2  PRODUCTS
2.01  MATERIALS
   A. Paint shall be waterborne or solvent borne found on the current Wisconsin Department of
      Transportation Qualified Pavement Marking Materials List, colors as shown or specified
      herein. Pavement marking paints shall comply with applicable state and local laws enact-
      ed to ensure compliance with Federal Clean Air Standards. Paint materials shall conform
      to the restrictions of the Local Air Pollution Control District.
   B. Waterborne Paint: Paints shall conform to FS TT-P-1952
   C. Solvent Borne Paint: Paint shall conform to FS A-A-2886 or AASHTO M248. Paint shall be
      non-bleeding, quick-drying, and alkyd petroleum base paint suitable for traffic-bearing sur-
      face and be mixed in accordance with manufacturer's instructions before application for
      colors White, Yellow, Blue, and Red.

Part 3  EXECUTION
3.01  LAYOUT
   A. Do not apply paint until paving has cured a minimum of 14 days.
   B. Use steel tapes, transits, and other surveying equipment which will allow the precise meas-
      urement of distances and angles.
   C. Perform layout with chalk or lumber crayon only.
   D. Remove grease, oil, dirt, or other surface contaminants which would affect the appearance or
      performance of the painting work.

3.02  APPLICATION
A. Install pavement markings according to the manufacturer's recommended procedures for the specified material.

B. Tolerances:
   1. General: Make lines parallel, evenly spaced, and with sharply defined edges.
   2. Line Widths:
      a. Plus or minus 1/4 inch variance on straight segments.
      b. Plus or minus 1/2 inch variance on curved alignments.

C. Protect completed work from damage.

3.03 CLEANING

   A. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other methods approved by architect.

   END OF SECTION
SECTION 32 31 13
CHAIN LINK FENCING AND GATES

PART 1 – GENERAL
1.1 SECTION INCLUDES
   A. 8' Tall Chain link Fencing
   B. Service Gates
   C. Pedestrian Gates
   D. Vinyl Slats

1.2 SHOP DRAWINGS AND PRODUCT DATA
   A. Submit shop drawings and product data.
   B. Clearly indicate plan layout, grid, spacing of components, accessories, fittings, and anchorage.
   C. Submit manufacturer's installation instructions and procedures.

1.3 REFERENCES
   A. ASTM A491 - Standard Specification for Aluminum Coated Steel Chain Link Fence Fabric
   B. ASTM A392 - Standard Specification for Hot Dipped Zinc Coated Galvanized Steel Chain Link Fence Fabric
   C. ASTM 1428 - Standard Test Method for Weight of Coating on Aluminum-Coated Iron or Steel Articles
   D. ASTM A120 - Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (galvanized) Welded and Seamless, for Ordinary Uses
   E. ASTM E8 - Tension Testing of Metallic Materials
   F. ASTM F552 - Standard Definitions of Terms Relating to Chain Link Fencing
   G. ASTM F567 - Standard Practice for Installation of Chain Link Fence
   H. ASTM F626 - Standard Specification for Fence Fittings
   I. ASTM F669 - Standard Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence
   J. FS RR-F-191J - Fencing, Wire and Post, Metal (and Gates, Chain Link Fence Fabric, and Accessories)
   K. RFS RR-F-00191 0 - Fencing, Wire and Post

PART 2 – PRODUCTS
2.1 MATERIALS, ALUMINUM COATED OR GALVANIZED
   A. ASTM A569 SS-40 Pipe.
   B. Chain Link Fence:
      1. Aluminum-coated steel, in accordance with ASTM A491. Thoroughly degrease, rinse, and coat fabric with clear acrylic lacquer by the complete immersion process in line with the weaving process before taking up into rolls for shipment. Minimum weight of aluminum coating is 0.40 oz/ft for 6 and 9 gauge, as measured in accordance with ASTM A428.
      2. Hot dipped, zinc coated, steel (galvanized) in accordance with ASTM A392. Minimum weight of coating shall be 2 oz. per sq. ft.
      3. Vinyl Coated Fence in accordance with ASTM F1665. (Alternate)
C. Tension Wire: Aluminized-coated steel, in a marcelled or coil spring configuration to provide stretch ability.
D. Fittings: In compliance with ASTM F626, galvanized steel.
F. Stair/ ADA hand railings as fabricated per site details.

2.2 COMPONENTS
A. Posts:
   1. 8' Tall Fence: SS-40 4.64 lbs/ft. 2.875” outside diameter
B. Corner and Terminal Posts:
   1. 8' Tall SS-40 4.64 lbs./ft 2.875” outside diameter.
C. Corner and terminal posts for service gates:
   1. 25' Wide or Less SS-40 6.56 lbs./ft 4” outside diameter
   2. 26' Wide or Greater Sch 40 18.97 lbs/ft 6.625” outside diameter
D. Top and Brace Rail (Straight Run): SS-40 1.84 lbs/ft 1.66” outside diameter tubular section.
Top Rail (Curves): SS-30 1.59 lbs/ft 1.66” outside diameter tubular section.
E. Chain Link Fabric:
   1. 2” mesh woven from 9 gauge aluminized steel wire, top selvage knuckled bottom selvage
      knuckled in accordance with ASTM A491 (General Fence Areas)
F. Bottom Tension Wire: 7 gauge galvanized or aluminized steel.
G. Tie Wires for securing chain link fabric to horizontal rails and to line posts over 2.375” OD: 6
   gauge aluminum alloy wire.
H. Hog Rings for securing chain link fabric to tension wire: 12 gauge aluminum alloy wire.

PART 3 – EXECUTION
3.1 INSTALLATION
A. Landscape finish grading shall be completed prior to setting line posts. Install line posts, corner posts, terminal posts and horizontal rails with brace bands, rail ends, rail sleeves, line post caps, tension bands, tension bars, chain link fabric and gates to provide a rigid structure for fence. Use manufacturer's standard fittings, fasteners and hardware.
B. Space line posts uniformly and on 8’ foot maximum centers.
C. Line posts driven a minimum of 5’ deep on 8’ tall fencing.
D. Set posts plumb and true to line and grade.
E. Corner and terminal posts set in 48” x 12” concrete footings or as indicated on the plan set documents. Hold concrete 3” below finish grade.
F. Position bottom of fabric 1.5” above finished grade with tension wire stretched taut between terminal posts 2” to 3” above bottom of fabric.
G. Knuckle top and bottom standards of all fabric.
H. Pass top rail through line post caps/angled arm and attach securely to terminal posts.
I. Install brace rail and adjustable truss rod between end, corner and gate posts and first line post.
J. Stretch chain link fabric taut between terminal posts, supporting its weight as necessary with temporary tie wires.
K. Attach fabric to end, corner and gate posts with tension bars and tension bands, using one less band than height of fabric of feet, or approximately 14” on center.
L. Attach fabric to horizontal rails and line posts with tie tires and to tension wire with hog rings, five (5) tie wires, or hog rings per 10’ bay, or approximately 24” on center. Fence fabric shall be placed on the inside of posts around track and placed on the outside of posts along perimeter fence.

M. Install gates and adjust true to fence line and grade.

3.2 CLEAN UP

A. Dispose of excessive material to certified landfill.

B. All pipe, concrete, fabric and miscellaneous parts shall be removed from site.

C. Grade subgrade to within 1” of finish subgrade after work is completed.

3.3 UTILITY LOCATES

A. All required Diggers Hotline locates and private utility locates shall be ordered and paid for by each contractor requiring the locate service.

END OF SECTION
SECTION 32 33 00
SITE FURNISHINGS

PART 1 GENERAL
1.01 WORK INCLUDED
A. The Contractor shall provide all labor, materials, equipment, and services necessary, or incidental to the completion of the work specified in this section.
B. Installation of Accessible parking space signs

PART 2 PRODUCTS
2.01 MATERIALS
A. Accessible Parking Space Sign
   1. 18”x12”, M.U.T.C.D. R7-8, aluminum rust free sign, with sealed outer surface over a microstructure that reflects light.
   2. 6”x12”, M.U.T.C.D. R2-8P, aluminum rust free sign, with sealed outer surface over a microstructure that reflects light.
B. Stop Sign
   1. 24”x24”, M.U.T.C.D. R1-1, aluminum rust free sign, with sealed outer surface over a microstructure that reflects light.
   2. 10’x3-1/8”x1-3/8" baked enamel U-channel post.

PART 3 EXECUTION
3.01 INSTALLATION
A. Wall Mounted Signs
   1. Mount metal signs to face of the building. Contractor shall provide their mounting method to the architect for approval prior to installation.
B. Post Mounted Signs
   1. Mount metal signs to galvanized steel post.
   2. Excavate hole for concrete footings in locations shown on construction drawings or install in bollard as denoted on plan.
   3. Set steel post a minimum of 5’ below finish grade and the bottom of sign 6’3” above finished grade.

END OF SECTION
SECTION 32 92 00
TURF AND GRASSES

PART 1 GENERAL
1.01 WORK INCLUDED
   A. Fertilizing
   B. Seeding
   C. Mulching
   D. Erosion Mat
   E. Maintenance

1.02 REFERENCES
   A. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.03 DEFINITIONS

1.04 REGULATORY REQUIREMENTS
   A. Comply with local governing regulatory agencies for fertilizer and herbicide composition.

1.05 QUALITY ASSURANCE
   A. Provide to project CONSTRUCTION MANAGER tags from seed mixture containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging prior to the start of seeding.

1.06 TESTS
   A. Testing is not required if recent tests are available for imported topsoil. Submit these test results to testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

1.07 MAINTENANCE DATA
   A. Submit maintenance data for the OWNER’S continuation of maintenance.
   B. Include maintenance instructions for the OWNER relating to cutting method and maximum grass height, type, application frequency, and recommended coverage of fertilizer to be utilized.

1.08 DELIVERY, STORAGE AND HANDLING
   A. Deliver grass seed mixture in sealed containers. Seed provided in damaged packages will not be accepted.
   B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.09 MAINTENANCE SERVICE
   A. Maintain seeded areas until acceptable growth is established.
   B. Maintenance
      1. Immediately re-seed areas which show bare spots.
      2. Protect seeded areas with warning signs during maintenance period.
   C. Acceptable Growth
1. When the majority of the seeding reaches the height of one-third greater than the anticipated cutting height, mowing should then follow standard frequency. (e.g. If a Kentucky Bluegrass turf is to be maintained at a 3-inch cutting height the new seedlings should be mowed when they reach a height of 4 inches.) After the second mowing and after the assessment that no washouts or large bare areas exist, the growth shall be deemed acceptable and from that point on, it is the OWNER’S responsibility.

PART 2 PRODUCTS

2.01 ACCEPTABLE SEED SUPPLIERS
   A. L.L. Olds Seed Company
   B. Reinders
   C. The Scott’s Company
   D. Horst Distributing
   E. Wisconsin Turf
   F. La Crosse Seed
   G. Or Approved by CIVIL ENGINEER

2.02 SEED MIXTURE
   A. Lawn Seed Mixture (General Turf Areas)
      50% Kentucky Bluegrass
      15% Creeping Red Fescue
      12% Chewing Fescue
      23% Improved Turf Type Perennial Ryegrass
      Or Approved by CIVIL ENGINEER
      Seeding Rate of 6 lbs. per 1,000 square feet
   B. La Crosse Michigan Green
      15% Kentucky Bluegrass
      40% Creeping Red Fescue
      30% Annual Ryegrass
      15% Perennial Ryegrass
      Or Approved by CIVIL ENGINEER
      Seeding Rate of 6 lb. per 1,000 square feet

2.03 SOIL MATERIALS
   A. Additional Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value: 5.4 minimum and 7.0 maximum.
   B. Salvaged Topsoil: Excavated from site and in accordance with Section 312000 - Earthmoving.

2.04 ACCESSORIES
   A. Mulching Material: Marsh hay or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
   B. Erosion Mat: Erosion mat shall be on the current Wisconsin Erosion Control Product Acceptability List (PAL)
   C. Fertilizer: Starter Fertilizer to the following proportions: Nitrogen 10 percent, phosphoric acid 18 percent, soluble potash 22 percent. Apply at rate of .5 lb N per 1000 S.F.
   D. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.
PART 3 EXECUTION

3.01 INSPECTION
   A. Verify that prepared soil base is ready to receive work of this section.
   B. Beginning of installation means acceptance of existing site conditions.

3.02 FERTILIZING
   A. Apply fertilizer in accordance with manufacturer’s instructions.
   B. Apply after smooth raking of topsoil and prior to roller compaction.
   C. Do not apply fertilizer at same time or with same machine as will be used to apply seed. Apply fertilizer after seed has been dragged and soil leveled.
   D. Mix thoroughly into upper 2” of topsoil.
   E. Lightly water to aid dissipation of fertilizer.

3.03 SEEDING
   A. Apply seed evenly in two (2) intersecting directions. Rake in lightly. Do not seed area in excess of that which can be mulched on same day.
   B. Planting Season: Starting May 1 through October 1.
   C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
   D. Drag seeded area with lightweight drag to cover seed and level soil.
   E. Immediately following seeding, fertilizing and compacting, apply mulch to a thickness of 1” to 1/2”. Maintain clear of shrubs and trees. Crimping of mulch shall be performed in two (2) directions after placement of mulch.

3.04 MAINTENANCE
   A. During the maintenance period, CONTRACTOR shall top-dress/over seed to repair all eroded or bare areas until substantial growth is established to prevent erosion or as approved by CIVIL ENGINEER/OWNER.

END OF SECTION
SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1  GENERAL
1.01  WORK INCLUDED
A. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for
the completion of the work specified in this section.
B. Installation of storm sewer pipe, inlet structures, and underdrain.

1.02  REFERENCES
Works Industry Improvement Program, 2835 North Mayfair Road, Milwaukee, WI 53223.
Wisconsin, Department of Transportation, Division of Highways.
C. Wisconsin Department of Safety and Professional Services (DSPS), Wisconsin Plumbing
Products Register, latest edition.

PART 2  PRODUCTS
2.01  STORM SEWER PIPE AND CULVERT PIPE
A. Storm sewer pipe shall meet the Standard Specifications for Highway and Structure
Construction, Latest Edition, State of Wisconsin, Department of Transportation, Division of
Highways Subsections 607.2.1 and 608.2 and are supplemented as follows:
B. The contractor may utilize either corrugated polyethylene (PE) pipe, corrugated polyvinyl
chloride (PVC) pipe, or reinforced concrete pipe (RCP) unless specifically called out on the
construction documents. Storm sewer will be accepted on the basis of a Manufacture’s
Certificate of compliance and field inspection upon delivery. Corrugated PE pipe and
corrugated PVC pipe shall also be reviewed to ensure that they are on the Department
of Transportation’s approved products list. All perforated pipe shall be fitted with an external filter
sock.
C. Corrugated PE pipe and fittings shall meet the requirements of the AASHTO specifications
for corrugated polyethylene pipe, diameter 12 to 36 inches. M294, Type S; and the Specifications
for Corrugated Polyethylene Drainage Tubing, Designation: M252-92, Type S, diameter 8 to 10
inches. Joint connections shall utilize gaskets as recommended by the manufacturer.
D. Corrugated PVC (polyvinyl chloride) pipe and fittings shall conform to the specifications of the
Standard Specification for Poly (vinyl chloride) (PVC) Corrugated Sewer pipe with a smooth
interior and fittings, ASTM Designation: F949. Joint connections shall utilize gaskets as
recommended by the manufacture and shall be 10 psi joint.
E. All storm sewer system materials shall meet the requirements set by the Wisconsin Plumbing
Products Registry.

2.02  INLET STRUCTURES
A. Concrete inlet structures shall conform to details in the plan and materials shall meet the
requirements of Section 611.2 of the Standard Specifications for Highway and Structure

2.03  CONCRETE MANHOLE CASTINGS AND GRATES
A. Neenah Foundary Casting and Grates or approved equivalent shall be provided as specified
in the construction documents for all concrete catch basins, manholes, and inlet structures.

2.04  MODULAR DRAIN INLETS
1. Modular inlets shall be as manufactured by Nyloplast (Advanced Drainage systems), or approved equal.
2. Basin size, pipe connection size alignment and invert as shown on drawings.
3. Grates shall be furnished by basin manufacturer and shall be considered an integral part of the surface drainage inlet. Manufacturer of cast iron grates shall conform to ASTM A-48-83 Class 30B.
4. Modular inlets shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the furnished configuration.
5. The joint tightness shall conform to ASTM 3212. Modular inlets shall meet the mechanical property requirements for fabricated fittings as described in ASTM F794, F949 and F1336.

2.05 PIPE BEDDING
   A. Pipe bedding shall conform to Section 312000 Earthmoving, 2.1.E Stone Bedding.

2.06 CONNECTIONS
   A. Connections between pipes shall be made by using fittings furnished by the manufacturer of the pipe and designed specifically for that purpose.

2.07 RIP RAP
   A. Rip Rap shall be sized in accordance with the plan set document and in accordance with Section 606 of the Wisconsin Department of Transportation Standard Specification for Highway and Structure Construction. Rip Rap shall be installed on a geotextile fabric conforming to subsection 645.3.6.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install storm sewer pipe in accordance with the Standard Specifications for Highway and Structure Construction, Latest Edition subsection 607.3 and supplemented as follows:
   B. Trench width shall be in accordance with ASTM Designation D2321 for the standard practice for Underground Installation of Flexible Thermoplastic Sewer Pipe. Minimum width of trench shall be not less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches.
   C. Joints for storm sewer pipe shall be sealed to 10 psi.

3.02 STORM SEWER OUTFALL

3.03 CLEANING CULVERTS AND STORM PIPES
   A. CONTRACTOR shall remove all silt and debris accumulated in the culverts and storm sewer pipe, including pipe, inlets and outlets of the system. This work shall be performed after the completion of paving and after all turf areas have an established sufficient growth of grass to prevent sediment runoff.

3.04 SEPARATION FROM WATER MAIN
   A. Storm sewer mains shall be placed at least 8 feet horizontally (center to center) from any existing or proposed water main. If, due to ledge rock conditions or physical barriers, the Project Manager determines that the 8-foot horizontal separation cannot be maintained, the horizontal separation may be reduced to a minimum of 3 feet if the bottom of the water main is at least 18 inches above the top of the sewer.
   B. When storm sewer mains cross under water mains, provide a minimum separation of 12 inches from the bottom of the water main to the top of the sewer. When storm sewer mains, provide a minimum of 18 inches from the bottom off the sewer to the top of the water main.
C. If an existing water main is encountered while laying the storm sewer and it is impossible to obtain the proper vertical separation, immediately inform the Project Manager and reconstruct the water main for a minimum distance of 8 feet on either side of the storm sewer to permit centering one full length of water main under the storm sewer.

END OF SECTION